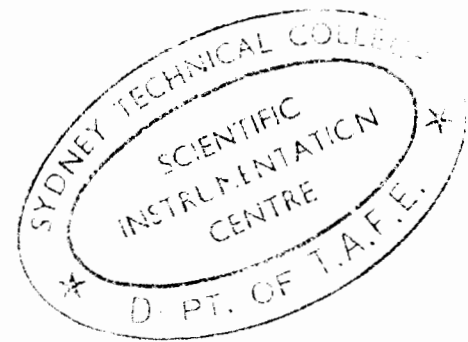




HP 1000 F-Series Computer

installation and service manual



HEWLETT
PACKARD

PRINTING HISTORY

The Printing History below identifies the Edition of this Manual and any Updates that are included. Periodically, Update packages are distributed which contain replacement pages to be merged into the manual, including an updated copy of this Printing History page. Also, the update may contain write-in instructions.

Each reprinting of this manual will incorporate all past Updates, however, no new information will be added. Thus, the reprinted copy will be identical in content to prior printings of the same edition with its user-inserted update information. New editions of this manual will contain new information, as well as all Updates.

To determine what manual edition and update is compatible with your current software revision code, refer to the appropriate Software Numbering Catalog, Software Product Catalog, or Diagnostic Configurator Manual.

Third Edition Dec 1981

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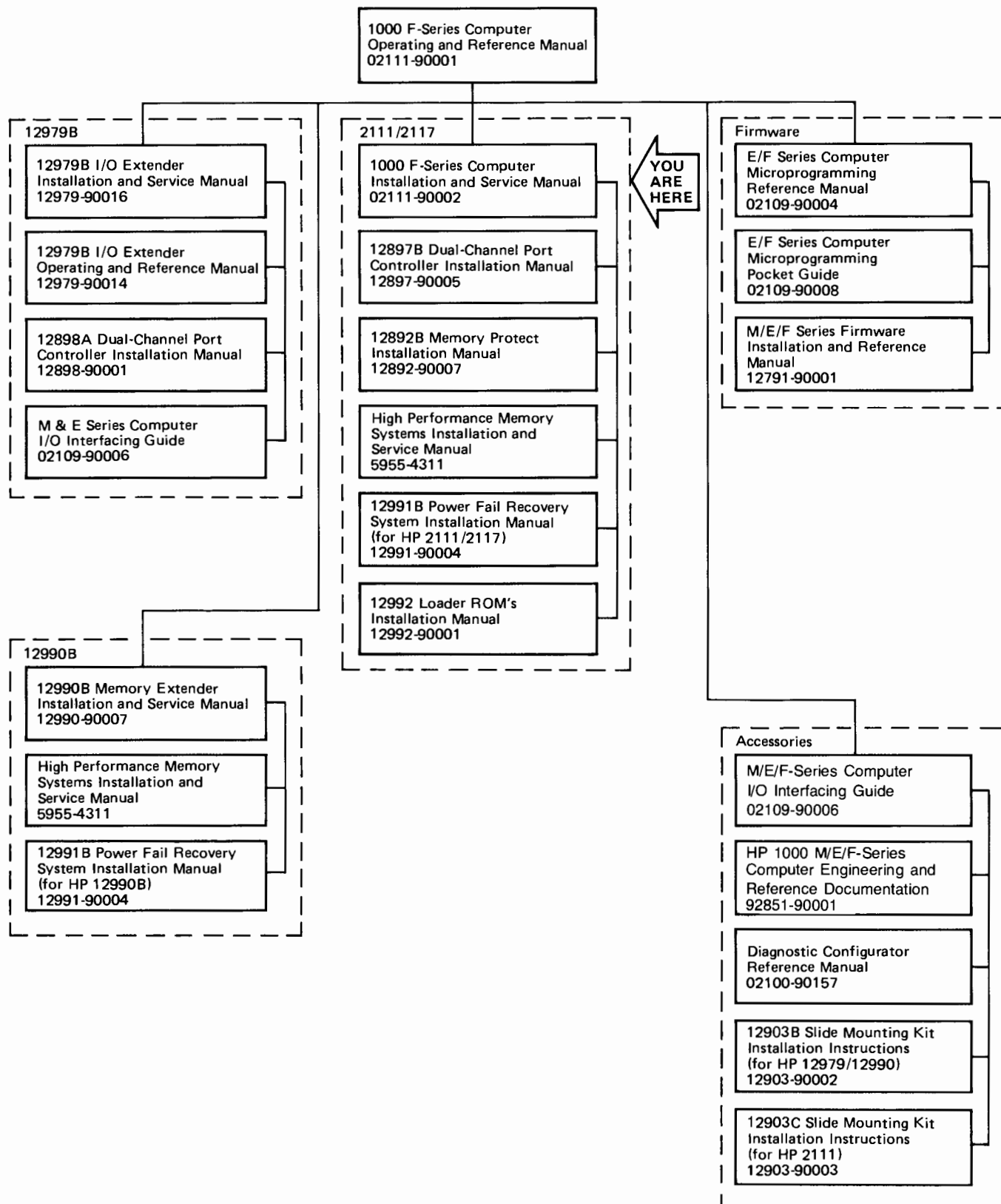
This manual provides installation and field service instructions for the Hewlett-Packard 1000 F-Series Computer. The HP 1000 F-Series Computer is a high technology product and, because of the product design, a modular replacement philosophy has been implemented to minimize on-site repair time.

Supporting documentation for the HP 1000 F-Series Computer are as follows:

- a. *HP 1000 F-Series Computer Operating and Reference Manual*, part no. 02111-90001.
- b. *HP 1000 F-Series Computer Installation and Service Manual*, part no. 02111-90002.
- c. *High Performance Memory Systems Installation and Service Manual*, part no. 5955-4311.
- d. *HP E/F-Series Computer Microprogramming Reference Manual*, part no. 02109-90004.
- e. *HP 12979B Input/Output Extender Installation and Service Manual*, part no. 12979-90016.
- f. *HP 12979B Input/Output Extender Operating and Reference Manual*, part no. 12979-90014.
- g. *HP 12990B Memory Extender Installation and Service Manual*, part no. 12990-90007.
- h. *HP 1000 M/E/F-Series Firmware Installation and Reference Manual*, part no. 12791-90001.
- i. *Diagnostic Configurator Reference Manual*, part no. 02100-90157.

An Engineering and Reference Documentation package, part no. 92851-90001, is also available to those who wish indepth knowledge about the architecture and logic elements of the HP 1000 M/E/F-Series Computer. Consult your local Hewlett-Packard Sales and Service Office for details regarding this package. A list of HP Sales and Services Offices is provided at the back of this manual.

DOCUMENTATION MAP



CONTENTS

Section I	Page	
INSTALLATION		
Site Preparation	1-1	
Environmental Limitations	1-1	
Power Requirements	1-1	
Cooling Requirements	1-1	
Mounting Considerations	1-1	
Unpacking and Inspection	1-2	
Physical Inventory	1-2	
Manuals	1-2	
Equipment	1-2	
Computer	1-2	
Floating Point Hardware	1-2	
Memory Systems	1-2	
Input/Output Interfaces	1-4	
I/O Cables	1-4	
Configuration Requirements	1-4	
Internal Switch Settings	1-4	
Parity Error Switch A1S1	1-6	
Automatic Restart Switch A1S2	1-7	
Remote Program Load Configuration		
Switches	1-7	
I/O Priority Assignment	1-7	
Installation Procedure	1-9	
Manual Updating	1-9	
Tools and Test Equipment Required	1-9	
Tools	1-9	
Test Equipment	1-9	
AC Power Outlet and External Ground	1-9	
Power Supply Check	1-11	
Power Supply Accuracy	1-11	
Power-Up Threshold	1-12	
Computer Mounting	1-12	
Bench Mounting	1-12	
Rack Mounting	1-13	
Floating Point Processor Mounting	1-13	
HP 2117F Cabling	1-13	
FFP-MPP Cable	1-13	
Power Control Cable	1-13	
Interface PCA	1-13	
Interfacing Cabling	1-13	
Performance Verification Check	1-13	
Claims Procedure	1-14	
Repacking for Shipment	1-14	
Shipment Using Original Packaging	1-14	
Shipment Using New Packaging	1-16	
Section II	Page	
SERVICE		
Preventive Maintenance	2-1	
Troubleshooting	2-1	
Power Supply Voltage Adjustments	2-1	
Voltage Adjustments without		
Power Fail Option	2-1	
Voltage Adjustments with		
Power Fail Option	2-2	
Floating Point Processor		
Power Supply	2-2	
Firmware Self-Tests	2-2	
CPU and Memory	2-2	
Floating Point	2-11	
FFP Test	2-13	
Scientific	2-13	
VIS	2-13	
Software Diagnostics	2-13	
Diagnostic Reference Manuals	2-13	
Subassembly Removal and Replacement	2-14	
Top, Side, and Bottom Covers	2-14	
Removal	2-14	
Replacement	2-14	
Firmware Accessory Board	2-14	
Removal	2-14	
Replacement	2-14	
Central Processor Unit PCA	2-14	
Removal	2-15	
Replacement	2-15	
Base Set Instruction ROMs	2-15	
Removal	2-15	
Replacement	2-16	
Standard and Optional Firmware ROMs	2-16	
Removal and Replacement	2-16	
Optional Loader ROMs	2-16	
Operator Panel PCA	2-17	
Removal	2-17	
Rocker Switch Contacts	2-17	
Replacement	2-17	
I/O Interface PCA's	2-17	
Removal	2-17	
Replacement	2-17	
Floating Point PCA's (HP 2111F)	2-17	
Removal	2-17	
Replacement	2-17	
Floating Point PCA's (HP 2117F)	2-18	
Removal	2-18	
Replacement	2-18	
Crossover PCA	2-18	
Removal	2-18	
Replacement	2-18	
Memory and I/O Backplanes	2-18	
Removal	2-18	
Replacement	2-18	
Computer Power Supply	2-18	
Removal	2-19	
Replacement	2-19	
Computer Power Supply Ventilating Fans	2-19	
Removal	2-19	
Replacement	2-19	

CONTENTS (continued)

Power Fail Recovery System	2-19
Battery Removal	2-19
Replacement	2-19
Battery PCA Removal	2-19
Replacement	2-21
Upper Ventilating Fans (HP 2111F)	2-21
Removal	2-21
Replacement	2-21
Upper Ventilating Fans (HP 2117F)	2-22
Removal	2-22
Replacement	2-22
Floating Point Processor Power Supply PCA's	2-22
Removal	2-22
Replacement	2-22
Floating Point Processor Power Supply	2-22
Removal	2-22
Replacement	2-22
Floating Point Processor	2-22
Ventilating Fans	2-22
Removal	2-22
Replacement	2-22

Floating Point Backplane (HP 2111F)	2-23
Removal	2-23
Replacement	2-23
Memory Cage PCA's	2-23
Removal	2-23
Replacement	2-23
Memory Reconfiguration	2-23
Memory Self-Test	2-23
110/220 Vac Reconfiguration for Computer Mainframe	2-23
Input Power Configuration for Floating Point Processor	2-24
Diagrams	2-24

Section III	Page
REPLACEABLE PARTS	
Computer Replaceable Parts	3-1
Power Supply Replaceable Parts	3-1
Floating Point Processor Replaceable Parts	3-1
Memory System Replaceable Parts	3-1
Ordering Information	3-1

ILLUSTRATIONS

Title	Page
Typical Identification and Information	
Labels	1-2
Computer Memory PCA Cage (Cage Cover Removed)	1-3
Computer I/O PCA Cage and Rear Panel	1-5
Internal Switch Configuration	1-6
Remote Program Load Configuration	
Switches	1-8
AC Power Cord Set (USA)	1-10
AC Power Cord Set (Non-USA)	1-10
Crossover PCA Voltage Test Points	1-11
Floating Point PCA Voltage Test Points	1-12
HP 2111F and HP 2117F Computer Power	
Fault Status LED	1-14
FFP-MPP and CPU-MPP Cable	
Connections	1-15
Troubleshooting Flowchart	2-3
Typical Memory Chip Malfunction Isolation for Less Than 128k Bytes of Memory	2-12

Title	Page
CPU Power Connections	2-15
Base Set Instruction ROMs Locations	2-15
Optional Loader ROM Sockets	2-16
Power Supply Circuit Breaker and Terminal Block	2-20
Power Fail Recovery PCA's Locations in the Power Supply	2-21
Computer Mainframe Power Distribution	
Diagram	2-25
Floating Point Processor Power Distribution	
Diagram	2-27
HP 1000 F-Series Computer Simplified Block Diagram	2-29
HP 2111F Computer Exploded View	3-3
HP 2117F Computer Mainframe Exploded View	3-5
Power Supply Interior View, with and without Battery Backup Boards	3-7
Floating Point Processor Exploded View	3-9

TABLES

Title	Page	Title	Page
Computer Environmental Limitations	1-1	HP 2111F Computer Replaceable Parts	3-2
Rack-Mounting Dimensions	1-1	HP 2117F Computer Mainframe	
Memory Slot Assignments	1-4	Replaceable Parts	3-4
Installation Test Equipment	1-9	Power Supply 5061-3476 Replaceable	
Computer Power Supply Voltages and		Parts	3-6
Tolerances	1-12	Floating Point Processor	
Preventive Maintenance	2-1	Replaceable Parts	3-8
Floating Point Self-Test Error Halts	2-13	Memory Systems and Accessories	
		Replaceable Parts	3-10
		Code List of Manufacturers	3-10

SAFETY CONSIDERATIONS

GENERAL - This product and relation documentation must be reviewed for familiarization with safety markings and instructions before operation.

SAFETY SYMBOLS



Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the product against damage.



Indicates hazardous voltages.



Indicates earth (ground) terminal (sometimes used in manual to indicate circuit common connected to grounded chassis).

WARNING

The **WARNING** sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in injury. Do not proceed beyond a **WARNING** sign until the indicated conditions are fully understood and met.

CAUTION

The **CAUTION** sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a **CAUTION** sign until the indicated conditions are fully understood and met.

CAUTION

STATIC SENSITIVE DEVICES

Some of the semiconductor devices used in this equipment are susceptible to damage by static discharge. Depending on the magnitude of the charge, device substrates can be punctured or destroyed by contact or mere proximity to a static charge. These charges are generated in numerous ways such as simple contact, separation of materials, and normal motions of persons working with static sensitive devices.

When handling or servicing equipment containing static sensitive devices, adequate precautions must be taken to prevent device damage or destruction. Only those who are thoroughly familiar with industry accepted techniques for handling static sensitive devices should attempt to service the cards with these devices. In all instances, measures must be taken to prevent static charge buildup on work surfaces and persons handling the devices. Cautions are included through this manual where handling and maintenance involve static sensitive devices.

SAFETY EARTH GROUND - This is a safety class I product and is provided with a protective earthing terminal. An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and be secured against any unintended operation.

BEFORE APPLYING POWER - Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual.

If this product is to be energized via an auto-transformer (for voltage reduction) make sure the common terminal is connected to the earth terminal of the main power source.

SERVICING

WARNING

Any servicing, adjustment, maintenance, or repair of this product must be performed only by qualified personnel.

Adjustments described in this manual may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside this product may still be charged even when disconnected from its power source.

To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow, time delay, etc.) are to be used for replacement.

WARNING

EYE HAZARD

Eye protection must be worn when removing or inserting integrated circuits held in place with retaining clips.



INSTALLATION

SECTION

I

This section provides installation instructions for the HP F-Series Computer. Included in these instructions are site preparation data, unpacking and inspection, configuration requirements, installation procedures, performance verification, and recommended packing and shipping methods.

1-1. SITE PREPARATION

Site preparation information for the computer includes environmental limitations, power requirements, and mounting considerations. If the computer is purchased as part of a computer system, disregard the contents of paragraphs 1-2 through 1-5 herein and refer instead to the Configuration and Site Preparation Guide for your system.

1-2. ENVIRONMENTAL LIMITATIONS

Environmental limitations for operating and non-operating conditions of the computer are specified in table 1-1. The environmental limitations imposed by peripheral devices and associated components must be taken into consideration when the computer is located in the same area.

Table 1-1. Computer Environmental Limitations

AMBIENT TEMPERATURE	
Operating:	0° to 55°C (32° to 131°F)
Nonoperating:	-40° to 75°C (-40° to 167°F)
ALTITUDE	
Operating:	4 570 metres (15,000 feet)
Nonoperating:	15240 metres (50,000 feet)
RELATIVE HUMIDITY	
20 to 95% at 25° to 40°C (77° to 104°F) without condensation.	

1-3. POWER REQUIREMENTS

The HP 2111F Computer is shipped with the power supply configured to operate from a single-phase power source of 88 to 132 volts (standard) or 176 to 264 volts (option 015) as specified in the purchase order. Maximum power consumption of the HP 2111F is 770 watts. Reconfiguring from 110V ac operation to 220V ac operation (or vice versa) is described in paragraph 2-84.

The HP 2117F Computer mainframe is shipped with the computer power supply configured to operate from a single-phase power source of 88 to 132 volts (standard) or 176 to 264 volts (option 015) as specified in the purchase order. However, the HP Floating Point Processor (FPP) of the HP 2117F is shipped with the power supply configured to operate from a single-phase power source of 108 to 132 volts or 198 to 242 volts. The ac voltage range of the FPP is the most significant since the computer will generate a power fail interrupt in the event of an FPP power supply shutdown. In some installations, it may be necessary to reconfigure the FPP power supply to match the available ac power source; reconfiguring information is given in paragraph 2-85. Reconfiguring the computer from 110V ac operation to 220V ac operation (or vice versa) is described in paragraph 2-84. Maximum power consumption of the computer and FPP is 970 watts.

Various safety codes require that instrument chassis, panels, and housings be grounded to protect operating and service personnel. A grounded three-conductor female power outlet must be made available to satisfy this requirement.

1-4. COOLING REQUIREMENTS

There are no external cooling requirements for the computer. The internal fans provide adequate ventilation when operated within the environmental limitations specified in table 1-1. Adequate space must be allowed on each side to ensure full intake and exhaust of ventilating air.

1-5. MOUNTING CONSIDERATIONS

The computer may be used either as a freestanding device or mounted in a standard 483-millimeter (19-inch) equipment rack. When used in a mobile environment, the computer should be installed in a shock-mounted equipment rack. Rack-mounting dimensions for the computer are specified in table 1-2.

Table 1-2. Rack-Mounting Dimensions

COMPUTER	HEIGHT	WIDTH*	DEPTH**
HP 2111F	311 mm (12-1/4 in.)	426 mm (16-3/4 in.)	622 mm (24-1/2 in.)
HP 2117F	445 mm (17-1/2 in.)	426 mm (16-3/4 in.)	622 mm (24-1/2 in.)
*Behind rack mount. **Required rack depth.			

1-6. UNPACKING AND INSPECTION

The computer and accessories may be shipped in more than one container. When the shipment arrives, check to ensure the receipt of all containers as specified by the carrier's papers. Inspect each shipping container immediately upon receipt for evidence of mishandling during transit. If any container is damaged, or if any container is waterstained, request the carrier's agent be present when that container is opened.

Open the shipping container marked "MANUALS AND ACCESSORIES". One of the items in this package is a list of equipment supplied. Compare this list against the purchase order to verify that the shipment is correct. Unpack the shipping container(s) and inspect each item for external damage. Look for damage such as broken controls and connectors, dented corners, bent panels, scratches, and loose components. Check also the rigid foam-plastic cushioning (if used) for signs of deformation which could be indicative of rough handling during transit.

If the visual examination reveals any damage to the computer or accessories, follow the damage claim procedure described in paragraph 1-40. Retain the shipping container(s) and packing material for examination in the settlement of claims or for future reuse.

1-7. PHYSICAL INVENTORY

1-8. MANUALS

Check to ensure that all manuals listed on the list of materials have been received.

1-9. EQUIPMENT

1-10. COMPUTER. The computer model number and serial number are written on an identification label affixed to the lower front frame and covered by the operator panel when closed. Ensure that both the model number and serial number are identical with those specified in the Installation Record. Typical identification and information labels are illustrated in figure 1-1.

If the computer 220V ac option is specified in the purchase order, it is installed and tested at the factory, and identified by the three-digit number, 015, written on the identification label and by the current/voltage rating on the metal tag attached to the rear panel of the power supply. Ensure that this number is identical with that specified in the Installation Record.

1-11. FLOATING POINT HARDWARE. The F-Series computers include hardware that executes 32- and 48-bit floating point operations two to six times faster than previous HP series 2100 software and firmware floating point subroutines. The floating point hardware also supports direct or subroutine microprogramming and chained floating point calculations via microprogramm-

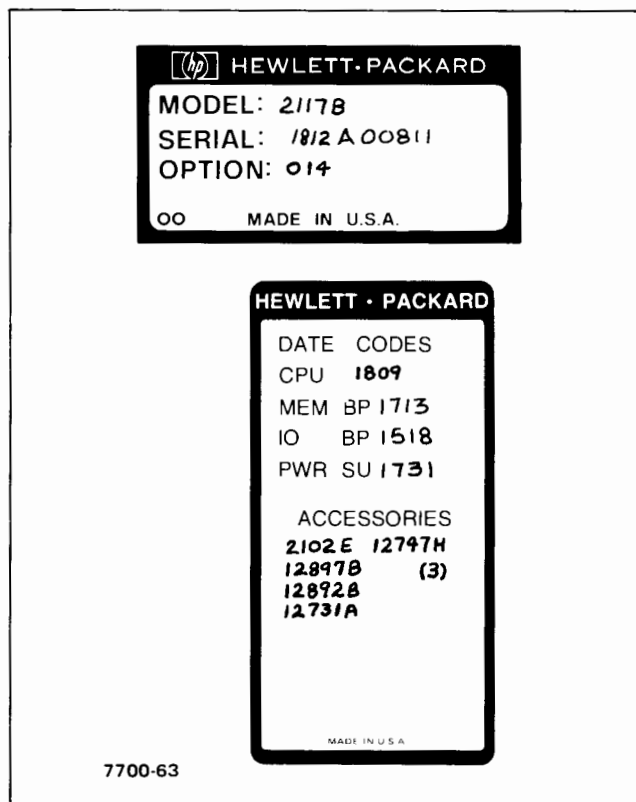


Figure 1-1. Typical Identification and Information Labels

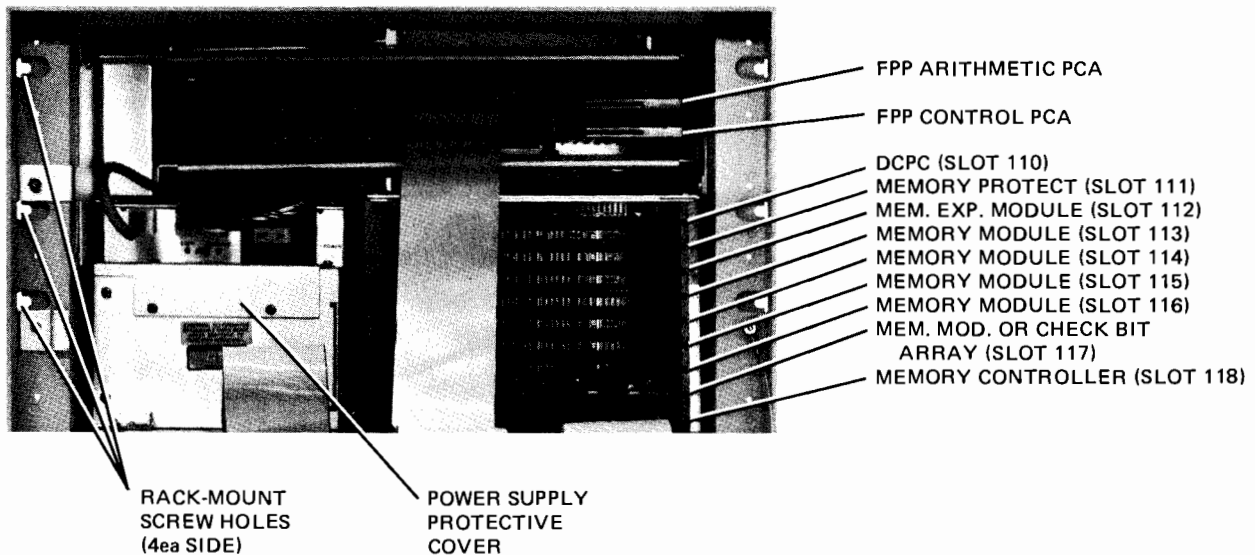
ing. In the HP 2111F the floating point hardware consists of two PCA's mounted in the computer mainframe. (See figure 1-2.) In the HP 2117F the floating point PCA's are mounted in a separate assembly, the Floating Point Processor (FPP), and cabled to the computer mainframe.

NOTE

The HP 2111F and the Floating Point Processor (FPP) are shipped with a plastic block behind the front panel. The block secures the floating point PCA's in place during shipment. Remove the block before applying power to the HP 2111F or the FPP.

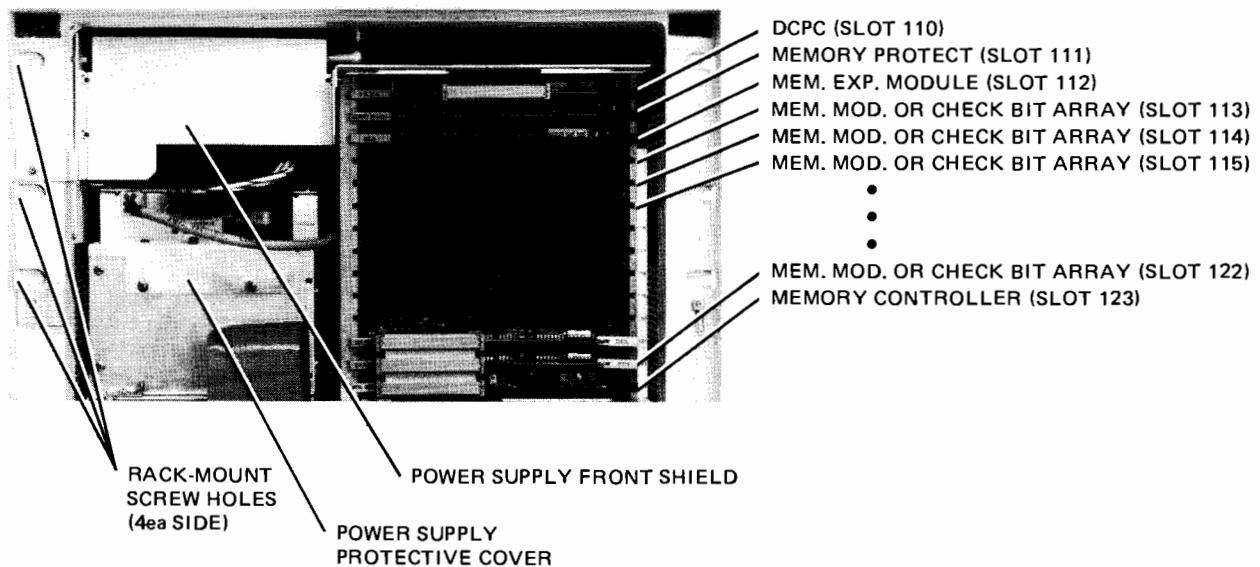
1-12. MEMORY SYSTEMS. The memory system and memory accessories specified in the purchase order are installed at the factory. The memory configuration is identified by the memory system model number and one or more accessory product numbers as illustrated in figure 1-1. Check these numbers to ensure the inclusion of the proper memory configuration specified in the Installation Record. Turn the key on the operator panel clockwise, lower the panel assembly to the memory access position, and remove the two screws and lockwashers holding the memory printed circuit assembly (PCA) cage cover. Remove the memory PCA cage cover and notice that the memory slot numbers are listed on the right-hand side of the memory PCA cage as shown in figure 1-2. These slot numbers are allocated to the functions listed in table 1-3,

HP 2111F COMPUTER



7700-206

HP 2117F COMPUTER



7700-205

Figure 1-2. Computer Memory PCA Cage (Cover Removed)

Table 1-3. Memory Slot Assignments

MEMORY SLOT	2111F ASSIGNMENTS	2117F ASSIGNMENTS
110	Dual Channel Port Controller	Dual Channel Port Controller
111	Memory Protect PCA	Memory Protect PCA
112	Memory Expansion Module	Memory Expansion Module
113	Memory Module	Memory Module
114	Memory Module	Memory Module
115	Memory Module or Check Bit Array	Memory Module
116	Memory Module or Check Bit Array	Memory Module
117	Memory Module or Check Bit Array	Memory Module
118	Memory Controller*	Memory Module
119	—	Memory Module or Check Bit Array
120	—	Memory Module or Check Bit Array
121	—	Memory Module or Check Bit Array
122	—	Memory Module or Check Bit Array
123	—	Memory Controller*

*Memory Controller must be installed in highest numbered slot (slot 118 for HP 2111F and slot 123 for HP 2117F).

which shows that the memory controller PCA must be installed in slot 118 for an HP 2111F or in slot 123 for an HP 2117F.

With an HP 2102E High Performance Memory System installed, only the HP 12741A 32k byte and the HP 12747H 128k byte memory modules can be used. With 128k byte memory modules, dynamic mapping in the computer, and an HP 12990B Memory Extender, main memory can be expanded to 1792k bytes in the HP 2111F and 2048k bytes in the HP 2117F Computer. The memory modules may also be used with a fault control memory controller and check bit array boards to provide a ten-fold or greater MTBF improvement of the memory system. A fault control memory system which consists of a controller and one or more check bit array boards, along with the appropriate number of memory modules, is capable of correcting all single-bit memory errors and of detecting all double-bit and most multiple bit errors. A fault control system is particularly valuable in computer systems with large amounts of memory, or where fault-secure operation is essential.

Verify that all connectors are seated firmly onto the PCA's front edge connectors. Replace the memory PCA cage cover and secure the operator panel after closing by turning the key counterclockwise until the panel is locked in place.

1-13. INPUT/OUTPUT INTERFACES. If input/output (I/O) interface PCA's have been ordered and are integrated into the computer system, loosen the captive screws holding the I/O cage cover in place at the rear of the computer as shown in figure 1-3. Verify that the proper I/O interface PCA's have been furnished in accordance with the purchase order and as specified in the Installation Record. Replace the I/O PCA cage cover.

If I/O interface PCA's have been ordered separately, ensure that they have been furnished with the shipment and in accordance with the purchase order and as specified in the Installation Record.

1-14. I/O CABLES. Verify that all required cables for the interface PCAs have been furnished.

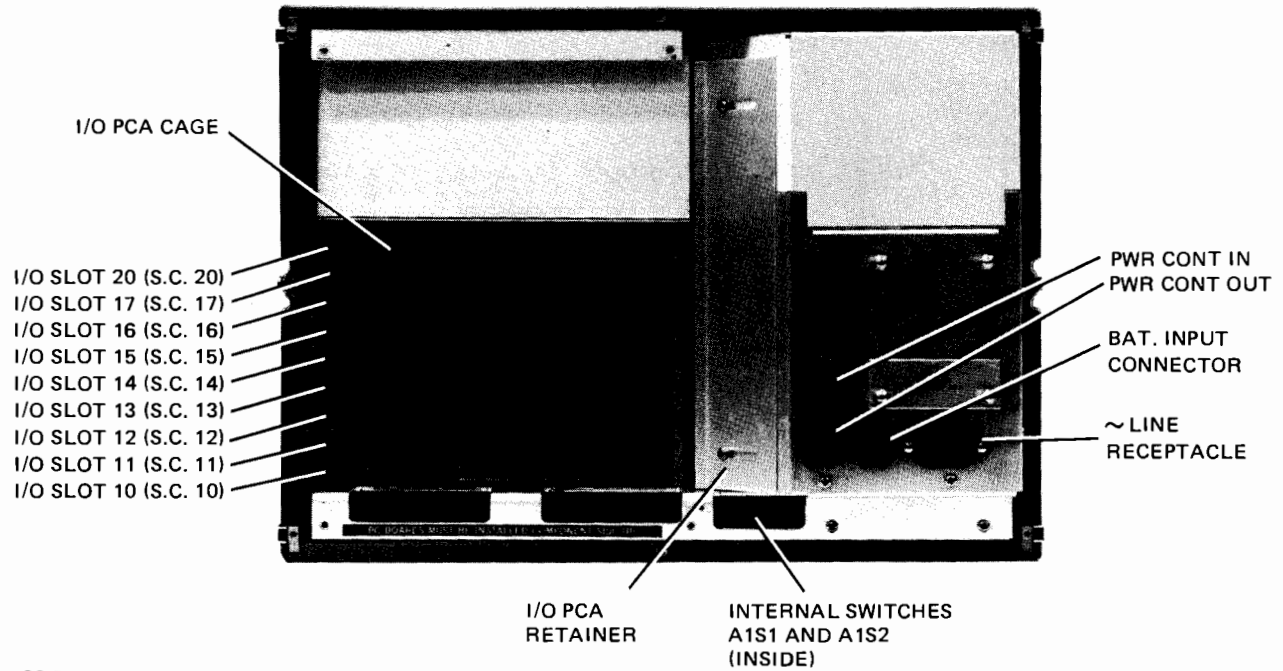
When installing the I/O cables, ensure that the cables are connected with the cable-end on the right-hand side of the I/O Cage (nearest the power supply) as viewed from the rear of the computer. The I/O cage cover has an opening on this side to allow room for the cables.

1-15. CONFIGURATION REQUIREMENTS

1-16. INTERNAL SWITCH SETTINGS

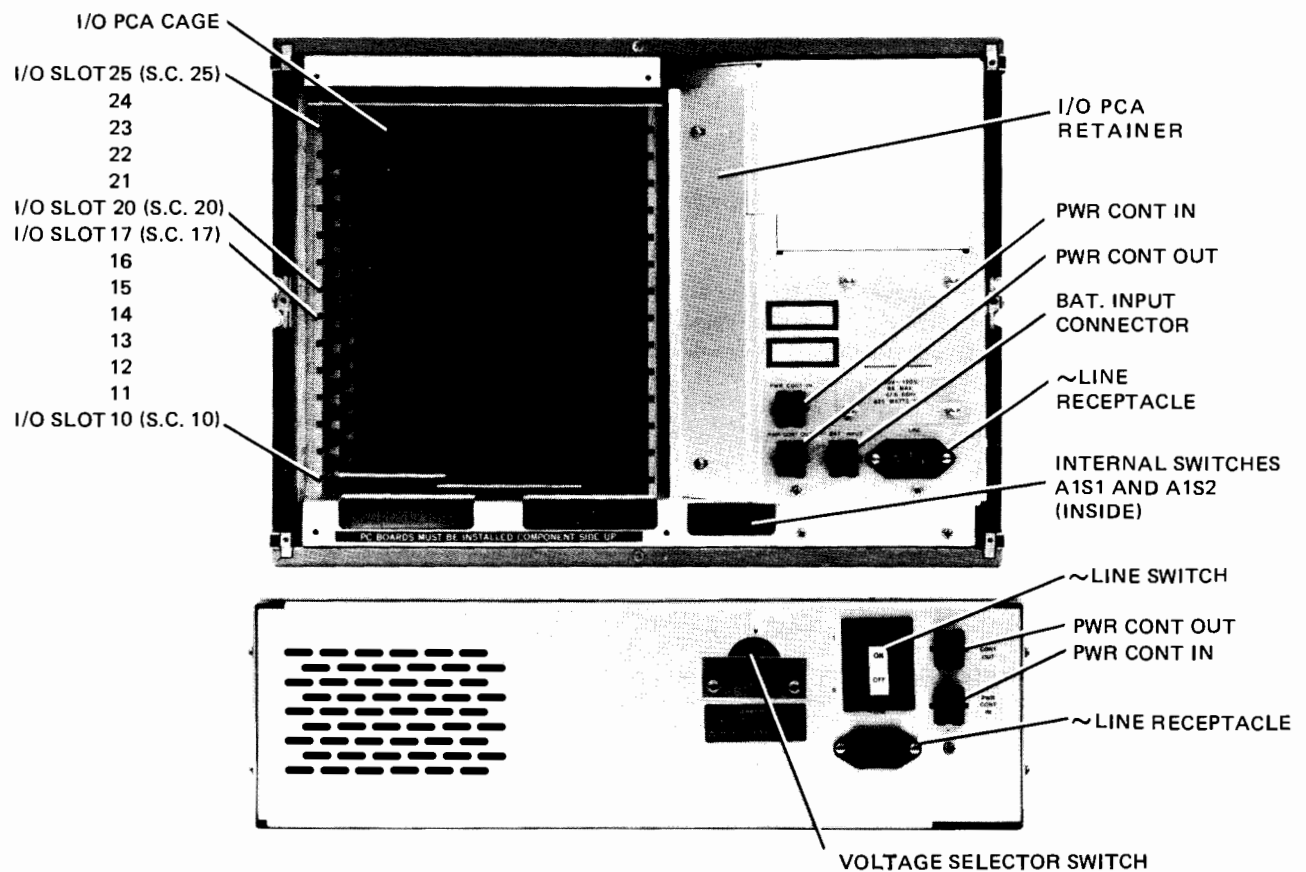
Remove the I/O PCA cage cover and locate the two toggle switches (A1S1 and A1S2) mounted on the rear of the central processor unit PCA. (See figures 1-3 and 1-4.) The position of switch A1S1 determines the action that the computer will take in the event of a parity error (or memory protection assuming that a memory protect PCA is installed) and the position of switch A1S2 will enable or disable the power fail/automatic restart capability. The proper setting of each switch depends on whether or not a user-written subroutine will be included to accommodate the required computer action. Therefore, refer to paragraphs 1-17 and 1-18 and then consult with the system programmer to determine the proper switch settings. Programming considerations concerning these switches are given in the *HP 1000 F-Series Computer Operating and Reference Manual*, part no. 02111-90001.

HP 2111F COMPUTER



7700-207

HP 2117F COMPUTER



7700-68

Figure 1-3. Computer I/O PCA Cage and Rear Panel

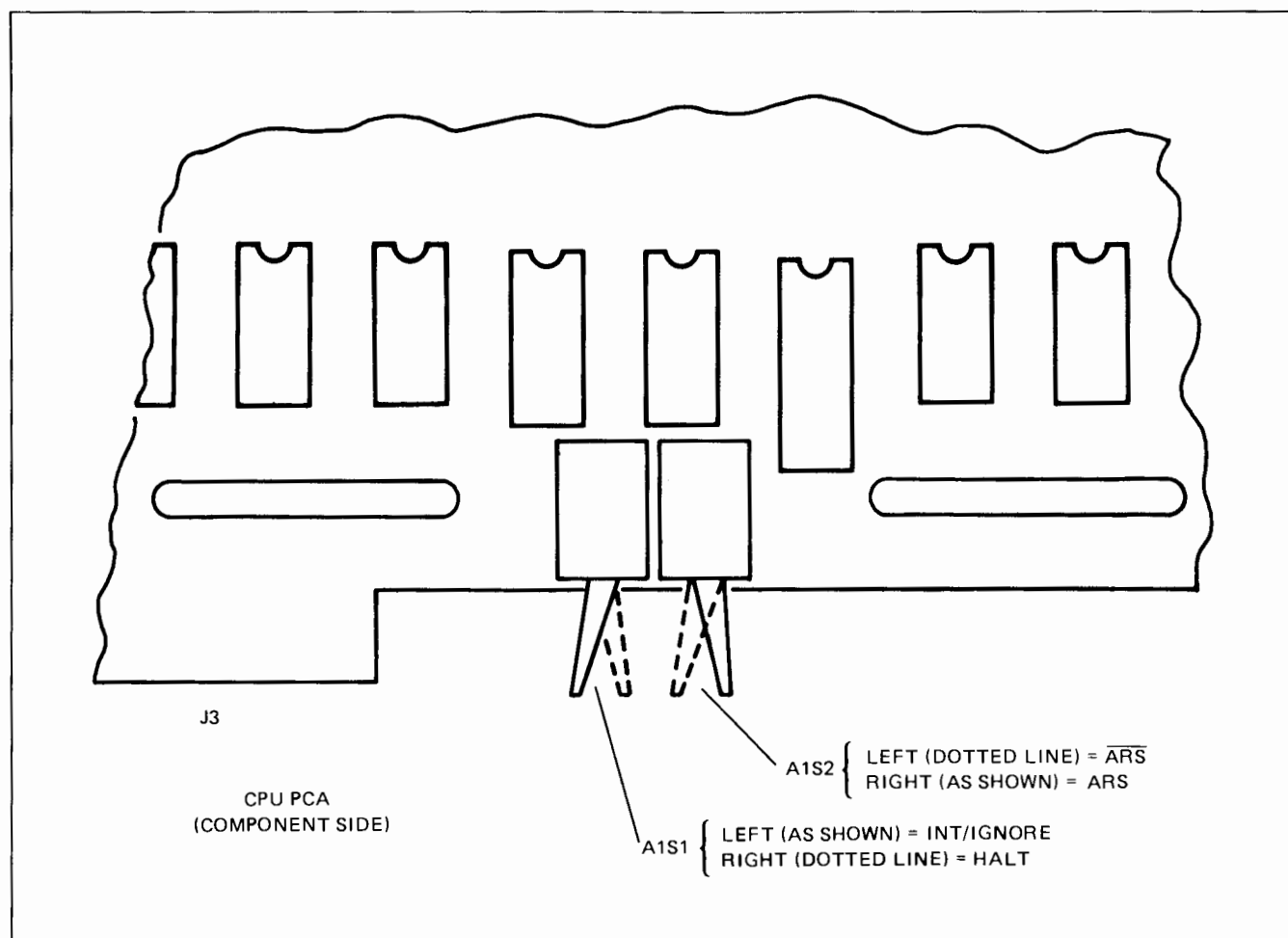


Figure 1-4. Internal Switch Configuration

Also mounted on the central processor unit (CPU) PCA are the remote program load (RPL) configuration switches. (See figure 1-5.) These switches are used as follows:

- Enable the remote program load (RPL) capability.
- Select one of our loader ROMs.
- Specify the select code of the loading device.

Configuration of these switches is described in paragraph 1-19.

1-17. PARITY ERROR SWITCH A1S1. The action that the computer will take when a parity error occurs is determined by the following alternative switch settings:

NOTE

Memory protect is a standard feature of the HP 2117F Computer and is optional for the HP 2111F. As shown in table 1-3, the memory protect PCA is dedicated to memory slot 111.

- HALT.** When switch A1S1 is in the HALT position and a parity error is detected during a read cycle, the computer will halt and light the PARITY indicator on the operator panel. The PARITY indicator will remain lighted until the PRESET switch is pressed.
- INT/IGNORE.** When switch A1S1 is in the INT/IGNORE position and a parity error occurs, the computer will take one of the following two actions depending on whether or not the memory protect PCA is installed:
 - If the memory protect PCA is installed and parity error interrupt has not been disabled by a CLF 05 instruction, an interrupt to memory location 00005 is generated.
 - If the memory protect PCA is not installed, or if the memory protect PCA is installed but the parity error logic has been disabled by a CLF 05 instruction, the parity error will be ignored and the PARITY indicator will light and remain lighted until the PRESET switch is pressed.

1-18. AUTOMATIC RESTART SWITCH A1S2. The action that the computer will take upon the restoration of primary power (following a momentary or prolonged power failure) is determined by the following alternative switch settings:

- a. **ARS.** The automatic restart feature is enabled when switch A1S2 is in the ARS position. After a built-in time delay of about half a second following the return to normal power levels, the computer will go into the RUN mode and interrupt to memory location 00004₈ provided that the memory was sustained. This permits entry into a restart program. If memory was not sustained, the computer will halt after the firmware diagnostic is completed. The POWER FAIL indicator will light when power is restored regardless of whether or not memory was sustained.
- b. **ARS.** The automatic restart feature is disabled when switch A1S2 is in the ARS position. The computer is halted immediately regardless of whether the computer was running or halted when the power failure occurred.

1-19. REMOTE PROGRAM LOAD CONFIGURATION SWITCHES. *NOTE: The RPL feature is fully described in the operating and reference manual for the F-Series computers.* As shown in figure 1-5, the remote program load (RPL) configuration switches consist of eight miniature rocker switches mounted on the CPU PCA at location U173S1-S8. These switches are shipped from the factory unconfigured and set to the open position. The switches may be configured, if the computer is shipped as part of a system. The user does not need to alter the RPL configuration switches if the RPL feature is not to be employed. If the RPL capability is desired, these switches are set to match the system's bootstrap loader configuration as follows:

NOTE

An optional loader ROM is required for remote program load; see HP 12992 Loader ROM Installation Manual, part no. 12992-90001 for optional ROM product numbers.

CAUTION

All contents of the memory will be lost when a PCA is removed from or installed in the memory PCA cage. Therefore, before turning off line and battery power, ensure that any memory contents to be saved are stored in another device for later retrieval.

- a. Turn key on operator panel clockwise and lower the panel to the access position.
- b. Set the ~ POWER switch to OFF.
- c. Set the BATTERY switch to the OFF position, if a Power Fail Recovery system is being used.

- d. Remove the two screws and lockwashers securing the memory PCA cage cover to the memory cage and remove the memory PCA cage cover.
- e. Disconnect cable assembly from all memory PCA's and DCPC cable assembly (if installed) from DCPC PCA.
- f. Remove all PCA's from memory PCA cage by pulling outward on extractor levers.
- g. At bottom of memory PCA cage, locate opening in deck for the RPL configuration switches (U173S1-S8) as shown in figure 1-5.
- h. Consult with the system programmer and configure the RPL configuration switches to match the system's bootstrap loader configuration.

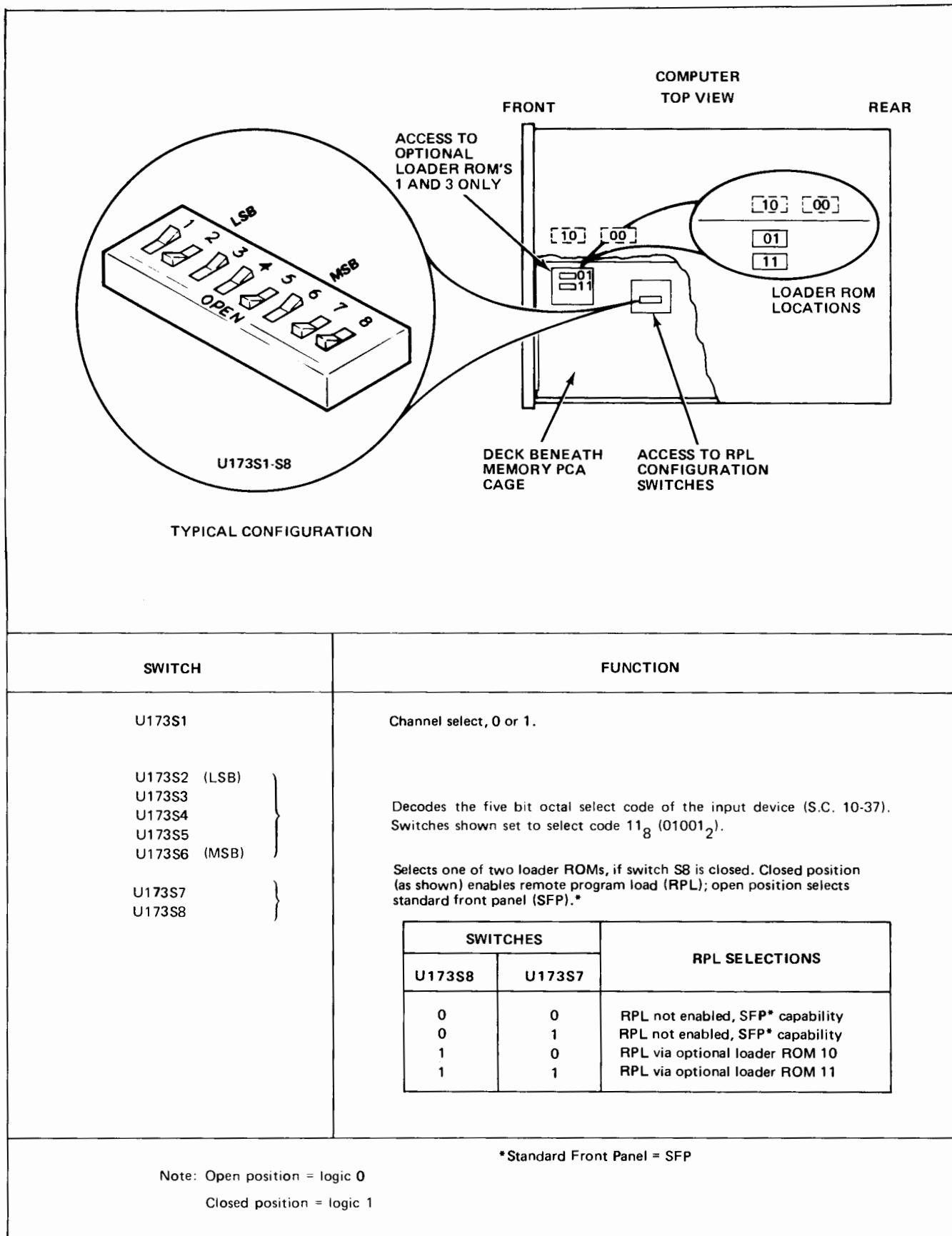
Figure 1-5 gives the function of each switch and an example of a typical configuration. The RPL capability is selected by setting switch U173S8 to the closed position as shown in figure 1-5. With the RPL enabled, bit 7 selects which of the two loader ROMs (ROM loader socket 10 or 11) will be used for the RPL routine. With RPL disabled control is passed to the standard front panel where program loading can be started manually. The I/O select code of the input device is configured by switches U173S2 through U173S6. Switch U173S1 selects the I/O device channel. The example in figure 1-5 shows the RPL enabled with loader ROM socket 11 selected and select code 11 (octal) as the I/O device on channel 0.

There are four loader ROM sockets numbered 00, 01, 10, and 11. The HP 2111F and HP 2117F computers come equipped with loader ROM 00 (paper tape loader ROM) in socket 00 and loader ROM 10 (7900/7905/7906/7920 disc loader ROM) in socket 10, leaving two sockets (01 and 11) available for additional loader ROMs. ROM loader sockets 10 and 11 are used with RPL if it is enabled. They are selected by switch U173S7 as illustrated in figure 1-5. To remove or install ROM's in sockets 00 and 10, it is necessary to remove the CPU PCA.

After setting the RPL configuration switches, replace all PCA's in memory PCA cage, reconnect cable assemblies, and reinstall memory PCA cage cover and close the operator panel.

1-20. I/O PRIORITY ASSIGNMENT

Each peripheral device in the system must be connected to the computer through an interface PCA installed in the I/O PCA cage. A priority chain connects all interface PCA's in series to prevent simultaneous interrupt requests from two or more peripherals. The priority of the interface PCA is determined by the I/O slot that the PCA occupies, with slot 10 (select code 10₈) having the highest priority; the highest numbered I/O slot has the lowest priority. (See figure 1-3.) Interrupts from a higher priority device inhibit lower priority interrupts by breaking the



7700-86

Figure 1-5. Remote Program Load Configuration Switches

priority chain. If the interrupt mode is used, there can be no vacant slots from select code 10₈ to the highest select code used due to the priority chaining scheme.

From a standpoint of time, it is more economical to assign the higher priorities to high-speed devices. However, if a subsystem could suffer catastrophic information loss if not serviced immediately, then that subsystem should be assigned the highest priority regardless of speed.

Refer to the individual interface or subsystem documentation for installation details concerning I/O PCA jumper assignments (if any) and priority considerations. Then confer with the system programmer to establish the desired I/O device priority and configure the I/O PCA cage accordingly.

1-21. INSTALLATION PROCEDURE

1-22. MANUAL UPDATING

Before installing the computer, perform any updating that may be required for the F-Series computer documentation. (A list of directly related hardware and software documentation is provided in the preface to this manual.) Updating instructions (if any) are provided in a supplement supplied with the appropriate document.

1-23. TOOLS AND TEST EQUIPMENT REQUIRED

1-24. TOOLS. No installation tools other than ordinary handtools are required.

1-25. TEST EQUIPMENT. Test equipment required to verify the adequacy of the ac power outlet and the proper adjustments of the computer power supply are listed in table 1-4.

1-26. AC POWER OUTLET AND EXTERNAL GROUND

The female power outlet to be used to supply ac power to the computer must be checked by a qualified electrician to ensure that it furnishes the proper voltage for which the

computer is configured. The outlet and its associated wiring and fuses (or circuit breakers) must be capable of carrying the current specified on the label on the computer rear panel. (See paragraph 1-10.)

Figures 1-6 and 1-7 illustrate and provide the necessary details of the various ac power cord configurations. If the computer is to be installed in a building, make sure that the local electrical code permits the use of the type of power cord furnished with the computer.

Have a qualified electrician check the power outlet with an ac voltmeter to ensure that the required single-phase voltage is present. If the computer is configured for 110-volt operation, the line voltage must be in the range of 88 to 132 volts ac (rms); for 220-volt operation, the line voltage must be in the range of 176 to 264 volts ac (rms). Bear in mind that the electrical load imposed by the computer and its accessories may reduce the line voltage below the no-load value.

If the line voltage is in the correct range, have the electrician also check the power outlet to ensure that it is wired correctly with respect to ac high potential, ac neutral, and earth ground. If the outlet is wired improperly, correction must be made by a qualified electrician. Local electrical codes must be observed if the installation is inside a building.

For safety reasons, it is *mandatory* that a connection be made between the computer chassis and earth ground. For installation in a mobile environment (e.g., ship, aircraft, or train), the earth ground wire in the computer ac power cord must be connected to the hull or metal frame of the vehicle.

An uninterruptible safety earth ground connection of no more than 6 ohms resistance must be provided to the computer via the power cables from the service entrance ground bus in accordance with local electrical code requirements. In addition, the voltage differential between neutral and earth ground shall not exceed 1-volt when measured at the computer power line input terminals. The fluctuation of this value must not exceed 25 millivolts peak-to-peak.

Table 1-4. Installation Test Equipment

INSTRUMENT	CRITICAL SPECIFICATIONS	RECOMMENDED MODEL
Digital Voltmeter	dc: At least four-digit readout. Minimum input impedance 10 megohms; full-scale ranges of 1.0000 and 100.00 volts dc. ac: Readout capable of measuring ac line voltage to $\pm 1.0\%$. Voltage range must be from 60 to 132 volts ac (standard) or 150 to 264 volts ac (option 015).	HP 34740A 4-digit display HP 34702A Multimeter Plug-In
Variable Autotransformer	Capable of reducing computer input line voltage to 60 volts ac (standard) or 150 volts ac (option 015); rated at least 1100 voltamperes.	None

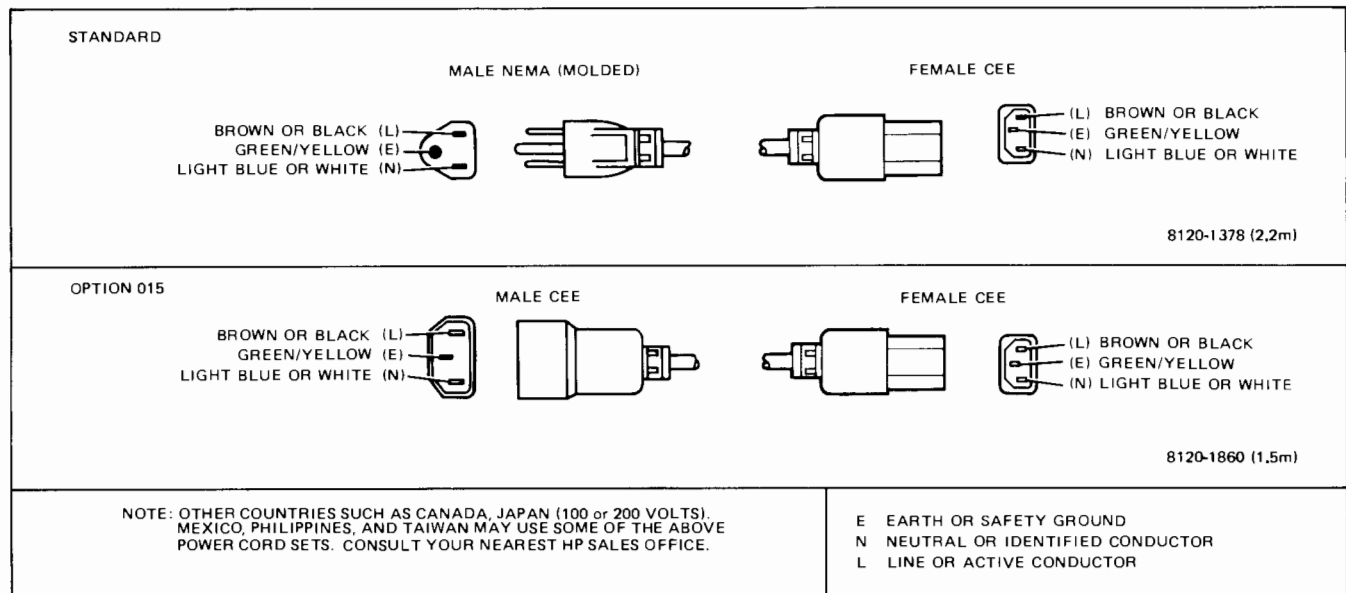


Figure 1-6. AC Power Cord Set (USA)

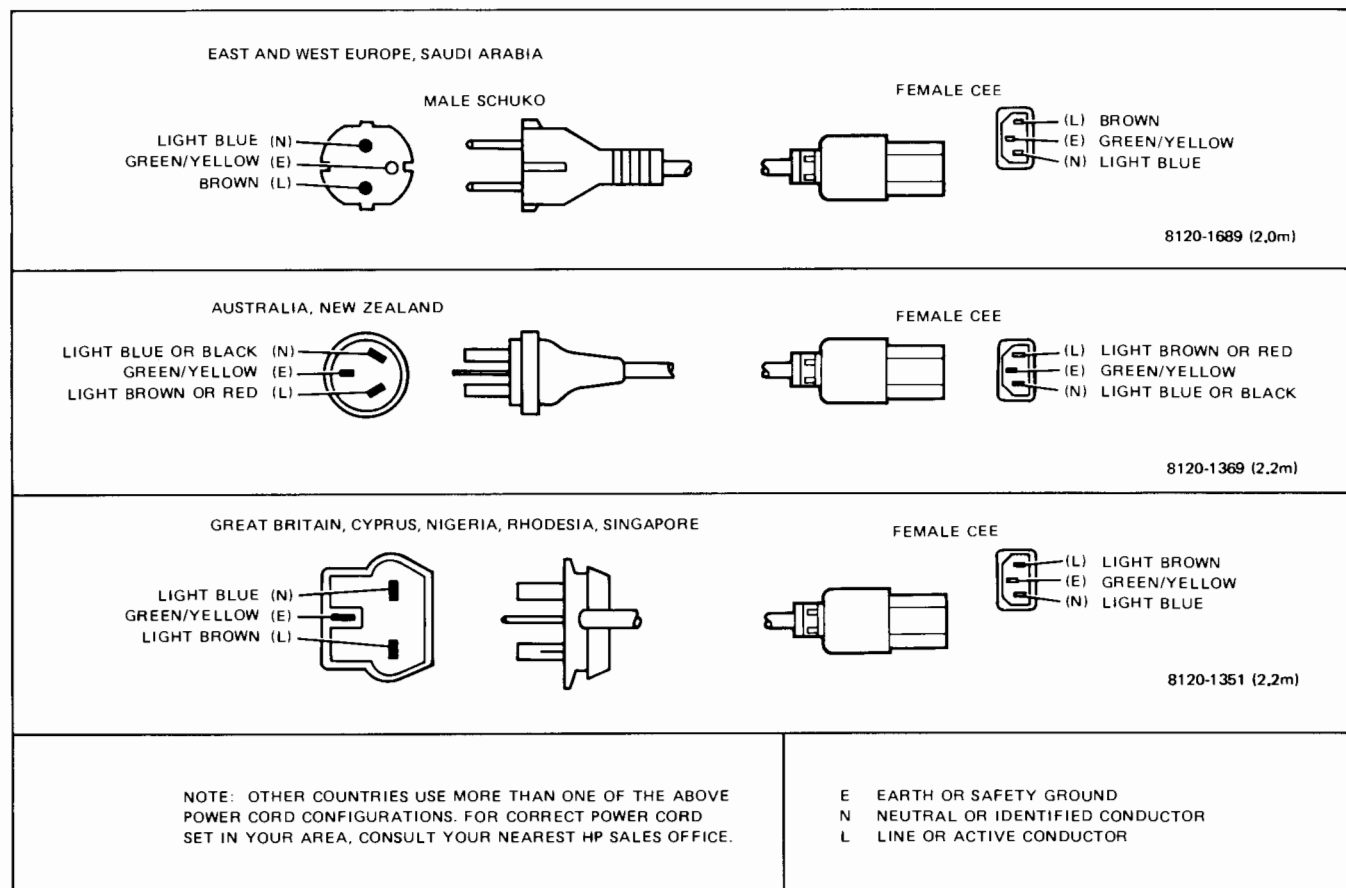


Figure 1-7. AC Power Cord Sets (Non-USA)

1-27. POWER SUPPLY CHECK

Verify the tolerances of the various power supply voltages and the power-up threshold as described in the following paragraphs. The power supply should be checked with all memory and I/O PCA's installed in the computer.

1-28. POWER SUPPLY ACCURACY. Energize the digital voltmeter and allow sufficient warm-up time to reach its rated accuracy. Proceed as follows:

WARNING

Hazardous voltages are present inside the computer mainframe!! Only qualified service personnel should perform the power supply accuracy checks. Before performing the power supply accuracy checks, set ~POWER switch to OFF and DISCONNECT THE POWER CORD!! Failure to observe this precaution can result in serious injury.

- a. Turn the key on the operator panel fully clockwise and lower the panel to the access position.
 - b. Plug the computer power cord into the power outlet and set extender ~POWER switch to ON. Set the LOCK/OPERATE to OPERATE.
 - c. Check the fault status LED on the front of the power supply. The LED is visible through the hole indicated in figure 1-10.
- NOTE
- If the fault status LED is ON or FLASHING, a fault condition exists. Notify the nearest Hewlett-Packard Sales and Service Office. A list of Sales and Service Offices is provided at the rear of this manual.
- d. If the fault status LED is OFF, proceed and check the tolerances of all output voltages at the crossover test points. Test points are shown in figure 1-8 and tolerances are listed in table 1-5.
 - e. On the 2111F, +5V can be measured between the +5V and ground test pins on the front of the floating point PCA's (figure 1-9), the light emitting diodes

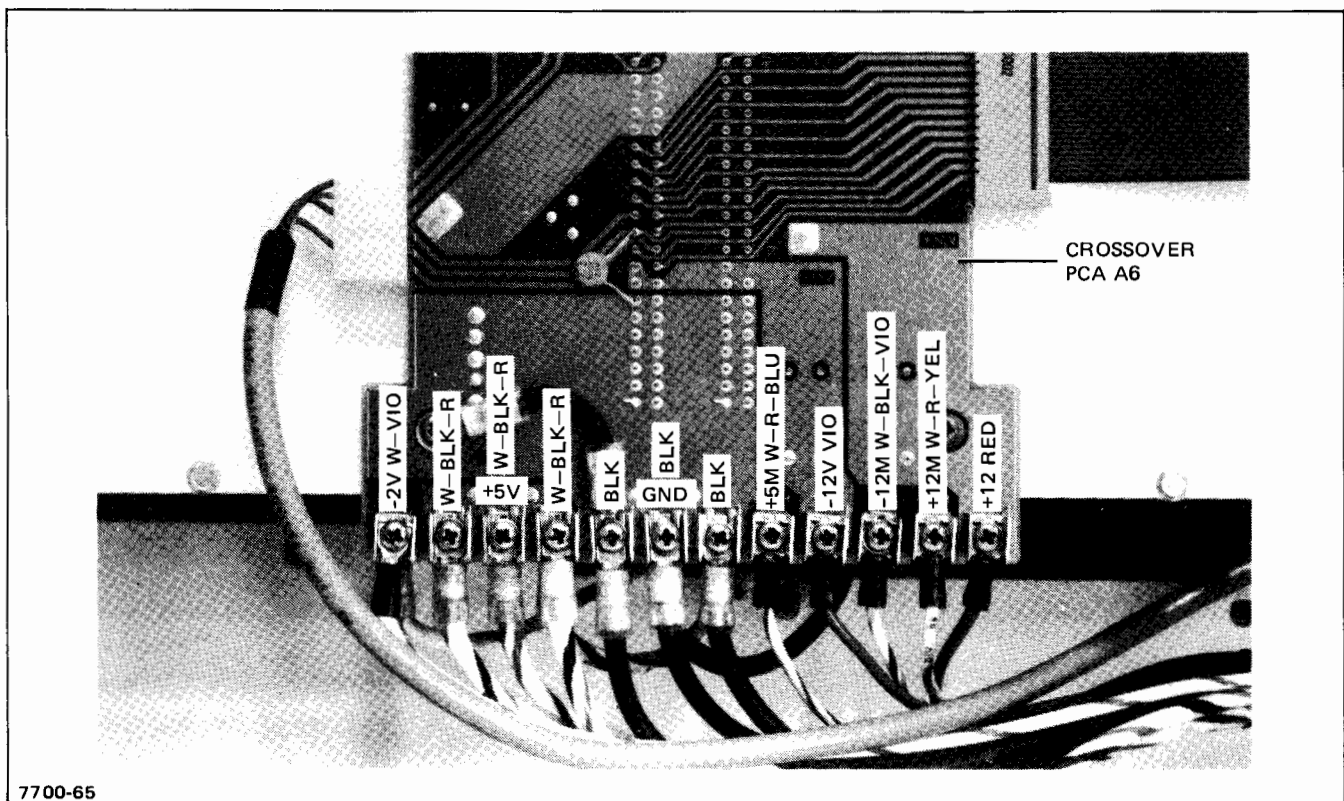


Figure 1-8. Crossover PCA Voltage Test Points

(LEDs) on the PCA's should be lit if +5V is approximately +5 volts. For all other voltages, the computer power must be turned off, the floating point PCA's removed, and the power turned on again.

NOTE

If one or more voltages are out of tolerance, notify the nearest Hewlett-Packard Sales and Service Office. A list of Sales and Service Offices is provided at the rear of this manual.

- f. On the Floating Point Processor (FPP), check the +5V voltage level as follows:
 - (1) On the rear panel of the FPP, set the ~LINE switch to OFF.
 - (2) Plug the ac power cord into a power outlet and set the ~LINE switch to ON.
 - (3) Remove the front panel of the FPP by grasping the panel handle and pulling.
 - (4) Connect the ground lead of the DVM to the ground test point on the front of a floating point PCA (figure 1-9) and the positive lead to the +5V test point. (The light-emitting diodes on the PCA's should be lit if the +5V voltage is approximately +5 volts.)
 - (5) Verify that the DVM indicates +4.75 to +5.25 volts and that both LED's are lit. If the voltage is not within tolerance or if either LED is not lit, notify your nearest Hewlett-Packard Sales and Service Office. (Refer to the office address list at the rear of this manual.)
 - (6) Repeat steps 4 and 5, connecting the DVM to the other floating point PCA.

Table 1-5. Computer Power Supply Voltages and Tolerances

SUPPLY VOLTAGE	MAXIMUM CURRENT	SUPPLY VOLTAGE		TEST POINT
		UPPER LIMIT	LOWER LIMIT	
+5V I/O	50A	+5.25Vdc	+5.00Vdc	A6 Crossover Assy +5V Out
+5V M	5.5A	+5.25Vdc	+5.00Vdc	A6 Crossover Assy +5M
+12V I/O	2.5A	+12.6Vdc	+11.4Vdc	A6 Crossover Assy +12V
+12V M	2.0A	+12.6Vdc	+11.4Vdc	A6 Crossover Assy +12M
-2V I/O	6.0A	-2.2Vdc	-1.8Vdc	A6 Crossover Assy -2V
-12V I/O	2.0A	-12.6Vdc	-11.4V	A6 Crossover Assy -12V
-12V M	250mA	-16Vdc (Unregulated)	-9Vdc	A6 Crossover Assy -12M
+30V I/O	250mA	+42Vdc (Unregulated)	+22Vdc	A6 Crossover Assy J2 Pin 4

1-29. POWER-UP THRESHOLD. The power-up threshold is below the lower limit of the mains voltage configuration, 88 volts rms (standard) or 176 volts rms (option 015). This threshold is non-adjustable.

1-30. COMPUTER MOUNTING

1-31. BENCH MOUNTING. As stated in paragraph 1-5, the computer may be used as a freestanding instrument in a land-based environment. The only consideration here is that adequate space be allowed on each side to ensure full intake and exhaust of ventilating air and that all covers are installed. Bear also in mind that a minimum

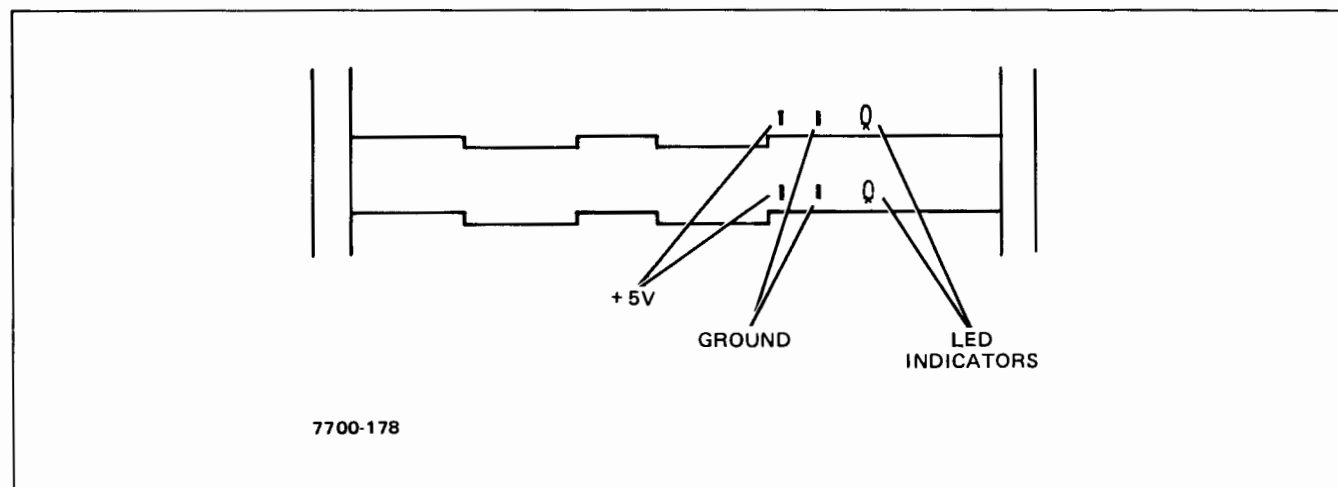


Figure 1-9. Floating Point PCA Voltage Test Points

30.5 centimeters (12 inches) of clearance behind the computer rear panel is required when removing and installing input/output interface PCA's.

1-32. RACK MOUNTING. The HP 12903C Chassis Slide Kit is available for rack mounting the computers. If a chassis slide kit has been ordered, mount the components to the sides of the computer and to the inside of the rack according to the instructions furnished with the kit. Then install the computer in the rack and secure the computer in place with screws inserted through the mounting holes identified in figure 1-2. If the computer is not installed with chassis slides, it is strongly recommended that the computer be supported by slide rails.

WARNING

Ensure cabinet or system stability before extending computer on its chassis slides.

1-33. FLOATING POINT PROCESSOR MOUNTING. Due to cabling restrictions the Floating Point Processor (FPP) must be mounted directly below or above the computer. As shipped from the factory the HP 2117F Computer's top and bottom covers are installed for mounting the FPP below the computer. If an HP 12990B Memory Extender is included in a system configuration, the extender must be mounted directly below the computer and the FPP must be above the computer. In this case, the top and bottom covers of the computer and the bottom cover of the extender must be rearranged to provide the necessary cable passages between the three units. The FPP is light enough to allow installation in the rack without the FPP being supported by any means other than the rack-mounting screws. However, it is recommended that additional support be provided by slide rails.

1-34. HP 2117F CABLING

Installation of the HP 2117F Computer requires the installation of two cables as described in the following paragraphs.

1-35. FPP-MPP CABLE. The FPP-MPP cable, part no. 12740-60008, connects the Floating Point Processor (FPP) PCA's to the microprogrammable processor port (MPP) on the operator panel PCA of the computer.

To install the FPP-MPP cable, proceed as follows:

- Switch off the FPP power; lower the operator panel and switch off the computer power.
- Remove the FPP front panel by grasping the panel handle and pulling.
- Connect the two closely-spaced connectors of the cable to connectors J2 on the FPP ARITHmetical and CONTROL PCA's. (See figure 1-11.)

- Pass the free end of the cable through the slot in the top (bottom if FPP mounted above computer) of the FPP and the bottom (top) of the computer.
- Connect the third connector to MPP connector J3 on the operator panel PCA (figure 1-11).
- Close the computer operator panel and replace the FPP front panel.

1-36. POWER CONTROL CABLE. The computer monitors the status of the FPP power supply via the power control cable, part no. 12740-60009. A power failure or power shutdown in the computer or the FPP causes the computer to generate a power fail interrupt, enabling an orderly system shutdown. Connect one end of the power control cable to the PWR CONT IN or OUT connector on the computer rear panel; connect the free end of the cable to the PWR CONT IN connector on the FPP rear panel.

1-37. INTERFACE PCA

1-38. INTERFACING CABLING. Cable requirements to interconnect interface PCA's and associated peripherals are specified in the appropriate interface kit or subsystem documentation. After all interface cables have been assembled, lower the operator panel to the access position, set the ~POWER switch to OFF, disconnect the battery cable, if present, and remove the input/output PCA cage cover. Install the hooded connector of each cable onto the edge connector of the interface PCA's from the right-hand side, as viewed from the rear of the computer. Connect the opposite end of each cable to the appropriate peripheral device, replace the I/O PCA cage cover. Ensure that the BATTERY switch is OFF and connect the battery cable, if present, to the BAT INPUT connector.

NOTE

If the power fail recovery system boards (A3A3 and A3A4) are installed in the power supply, the computer *will not* start if the battery cable is not connected or connector 12991-60002 is not connected to the BAT INPUT connector.



Set the LOCK/OPERATE switch to OPERATE and the ~POWER switch to ON, and if a power fail recovery system is installed, set the BATTERY switch to INT.

1-39. PERFORMANCE VERIFICATION CHECK

Verify the system installation and operation by running the diagnostic programs outlined in figure 2-1 of this manual. The following hardware is required for the diagnostic:

- At least 32k bytes of memory.
- A diagnostic input device.

1-40. CLAIMS PROCEDURE

If the shipment is incomplete or if the equipment is damaged or fails to meet specifications, notify the nearest Hewlett-Packard Sales and Service Office. If damage occurred in transit, notify the carrier also. Hewlett-Packard will arrange for replacement or repair without waiting for settlement of claims against the carrier. In the event of damage in transit, retain the packing carton and packaging materials for inspection.

1-41. REPACKAGING FOR SHIPMENT

CAUTION

When shipping the computer with a power fail recovery system installed, the following procedure must be followed:

- a. The battery box must be securely fastened to the computer.

- b. Set the BATTERY switch to OFF, disconnect the battery cable from the BAT INPUT connector and place protective sleeving or masking tape over the battery connector.
- c. Place protective sleeving or masking tape over the BAT INPUT connector.

When shipping a power fail recovery system that is not installed in the computer, follow step b above.

1-42. SHIPMENT USING ORIGINAL PACKAGING

The same containers and materials used in factory packaging can be used for reshipment of the computer. Alternatively, containers and packing materials may be obtained from Hewlett-Packard Sales and Service Offices. If the computer is being returned for servicing, attach a tag

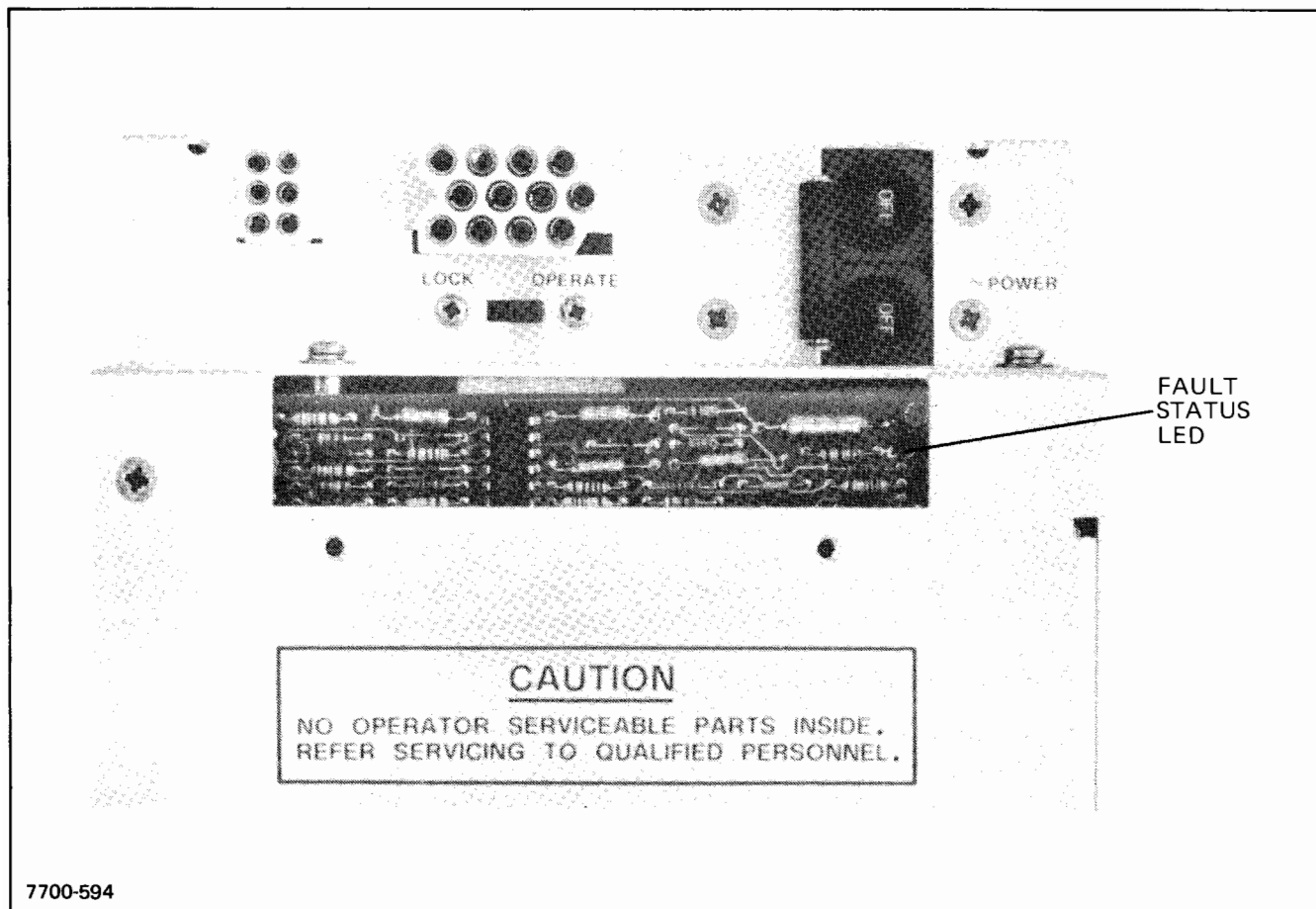


Figure 1-10. HP 2111F and HP 2117F Computer Power Supply Fault Status LED

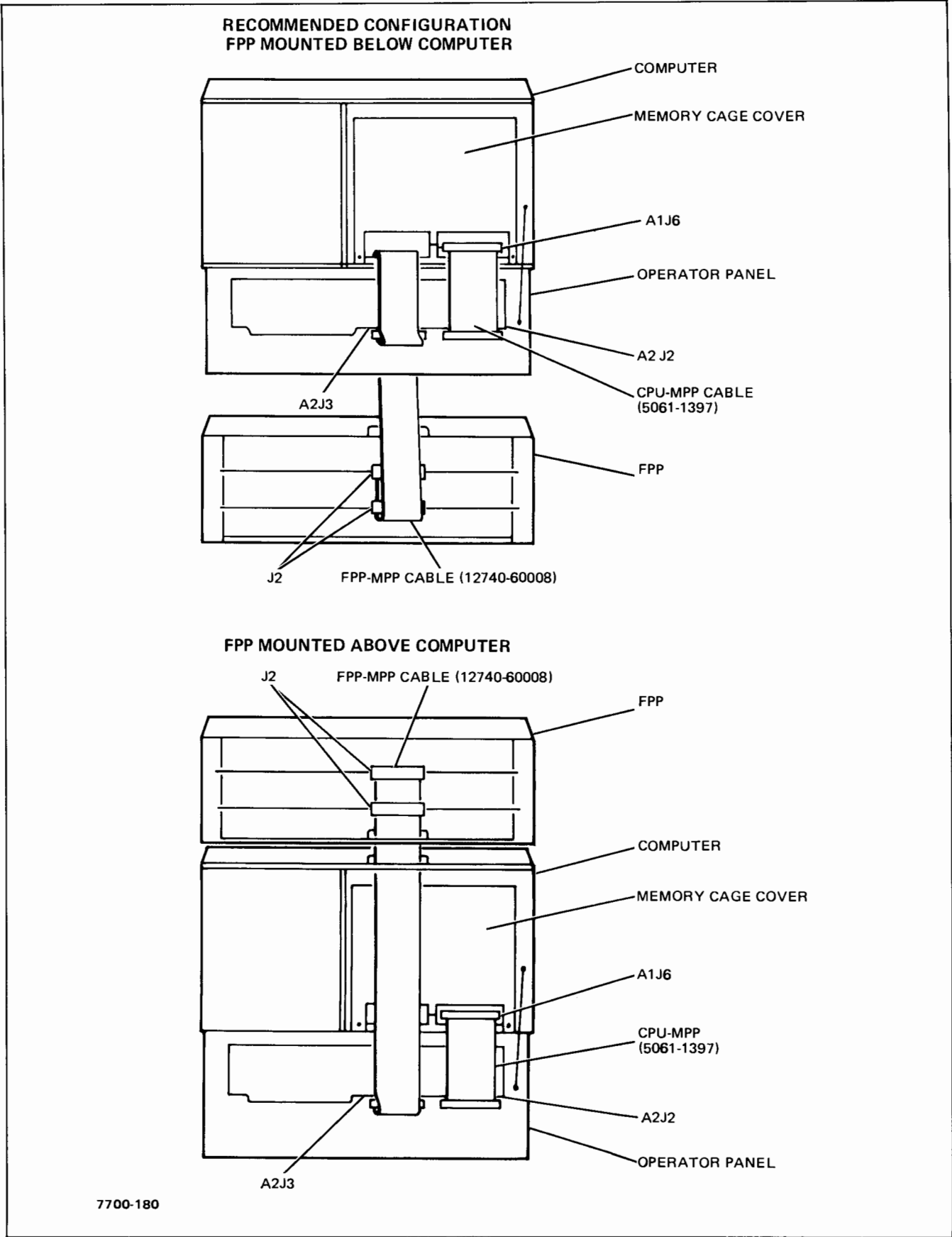


Figure 1-11. FPP-MPP and CPU-MPP Cable Connections

to the computer specifying the type of service required together with the computer model number and full serial number. Mark the container "FRAGILE" to ensure careful handling. In any subsequent correspondence, refer to the computer by model number and full serial number.

1-43. SHIPMENT USING NEW PACKAGING

The following instructions should be used as a guide when packaging the computer with commercially available materials:

- a. Wrap the computer in heavy paper or sheet plastic. If shipping the computer back to Hewlett-Packard, first attach a tag to the computer with the return address and indicating the type of service required. Include the computer model number and full serial number.
- b. Use a strong shipping container. A double-wall carton constructed of 2.41 MPa (350-psi) test material is adequate.
- c. Use sufficient shock-absorbing material on all sides of the computer to provide a firm cushion and to prevent movement inside the container. Use particular care to protect the computer corners and front and rear panels.
- d. Seal the shipping container securely and mark it "FRAGILE".
- e. In any subsequent correspondence with Hewlett-Packard refer to the computer by model number and full serial number.



SERVICE

SECTION

II

This section includes preventive maintenance; a troubleshooting flowchart for isolating malfunctions to the subassembly level; procedures for removing and replacing the various computer subassemblies; and a listing of the backplane signal sources and destinations, signal mnemonics, and mnemonic definitions. Also included are a simplified block diagram and a power distribution diagram.

2-1. PREVENTIVE MAINTENANCE

The preventive maintenance outlined in table 2-1 should be performed on a semiannual basis under normally clean operating conditions. If the adverse conditions are more severe, perform the preventive maintenance as often as necessary.

Table 2-1. Preventive Maintenance

1. Clean equipment exterior and interior
2. Using digital voltmeter (table 1-4), check power supply voltages as specified in paragraph 1-28.
3. Check fans for proper operation.
4. Check operation of all operator panel switches and indicators.
5. If installed, perform fault control memory preventive maintenance as specified in the High Performance Memory Systems Installation and Service Manual.
6. Perform the verification check as specified in paragraph 1-39.

2-2. TROUBLESHOOTING

Computer malfunctions can be isolated to the subassembly level by performing in sequence the procedure presented in figure 2-1. When a malfunction is encountered, replace the first suspect subassembly and repeat that portion of the procedure where the malfunction occurred. (Subassembly removal and replacement procedures are given in following paragraphs.) If the malfunction persists, reinstall the original subassembly, replace the next suspect subassembly, and again repeat the procedure. After the malfunction is cleared, contact the nearest Hewlett-Packard Sales and Service Office for instructions regarding shipment of the defective subassembly.

2-3. POWER SUPPLY VOLTAGE ADJUSTMENTS

WARNING

Hazardous voltages are present with the ac power cord connected. Ensure that the ac power cord is disconnected before proceeding.

The adjustments should be made with the same number of I/O and memory modules in the computer as will be used for normal operation. The adjustments will be given for operation with and without the power fail option.

NOTE

The adjustments are necessary only if the power supply check procedure given in paragraph 1-28 shows that a power supply voltage is out of tolerance.

2-4. VOLTAGE ADJUSTMENTS WITHOUT POWER FAIL OPTION. Proceed as follows:

- a. Set the LOCK/OPERATE switch to OPERATE and the ~POWER switch to ON.
- b. Connect the DVM to the +12M test point on the crossover PCA. Note that for the HP 2111F, this requires that the computer power must be turned off, the floating point PCA's removed, and the power turned on again.
- c. Adjust potentiometer A4R12 on the Jumper Board (see figure 3-3) for an indication of $+12.0 \pm 0.6$ volts on the DVM. Note that on the HP 2111F, this adjustment requires that the power supply be moved rearward within the computer to allow access to the potentiometer. The potentiometer is accessible through the cutout in the top cover.

There is no adjustment for any other voltage supply.

NOTE

All other voltages should be within specifications as stated in table 1-5. If any of the voltages is not within the stated specifications, refer to the troubleshooting flowchart in figure 2-1, sheet 1.

2-5. VOLTAGE ADJUSTMENTS WITH POWER FAIL OPTION. Proceed as follows:

- a. Disconnect the power cord from the line (mains) power and remove the power supply from the computer.
- b. Remove the top cover from the power supply and the top cover from the computer.
- c. Reinstall the power supply in the computer and reconnect all cables.
- d. Set the BATTERY switch to OFF.
- e. Set the ~POWER switch to OFF and connect the power cord to the line (mains) power.
- f. Set the LOCK/OPERATE switch to OPERATE and the ~POWER switch to ON.
- g. Connect the DVM to the +5M test point on the crossover PCA. Note that for the HP 2111F, this requires that the computer power must be turned off, the floating-point PCA's removed, and the power turned on again.

NOTE

On the HP 2111F, the following adjustments require that the power supply be moved rearward within the computer to allow access to the adjustment potentiometers.

- h. Adjust A4R1 on the Battery Backup Board (figure 3-3) until the DVM indicates $+5.00 \pm 0.25$ volts.
- i. Connect the DVM to the +12M test point on the crossover PCA.
- j. Adjust A4R2 on the Battery Backup Board (figure 3-3) until the DVM indicates $+12.0 \pm 0.6$ volts.
- k. Connect the DVM to the REF terminal on the Battery Charger Board (A3, figure 3-3).
- l. Adjust A3R2 on the Battery Charger Board (figure 3-3) until the DVM indicates $+5.0 \pm 0.25$ volts.
- m. Connect the DVM to the CUT OFF terminal on the Battery Charger Board.
- n. Adjust A3R3 on the Battery Charger Board (figure 3-3) until the DVM indicates approximately $+16.25 \pm 0.25$ volts.

NOTE

All other voltages should be within specifications as stated in table 1-5. If any of the voltages cannot be adjusted to within the stated specifications, refer to the troubleshooting flowchart in figure 2-1.

Turn off the computer and disconnect the ac power cord. Replace the covers of the power supply, reinstall the supply, and replace the computer top cover.

2-6. FLOATING POINT PROCESSOR POWER SUPPLY. Check the +5V voltage level of the Floating Point Processor (FPP) as follows:

- a. On the rear panel of the FPP, set the ~LINE switch to ON.
- b. Remove the front panel of the FPP by grasping the panel handle and pulling.
- c. Connect the DVM between the GND (ground) and the +5V test points on the front of the floating point PCA (figure 1-9).
- d. Verify that the DVM indicates $+4.75$ to $+5.25$ volts.
- e. Repeat steps c and d, connecting the DVM to the other floating point PCA.

NOTE

If the voltage on either floating point PCA is not within specifications, troubleshoot the FPP using the procedure given in figure 2-1.

Turn off the FPP and disconnect the digital voltmeter. Replace the FPP front panel.

2-7. FIRMWARE SELF-TESTS

2-8. CPU AND MEMORY. The computer is furnished with a standard microprogrammed base set that includes three tests that quickly test the computer and memory. These firmware diagnostics are not designed as a substitute for more complex software diagnostics and it may frequently be the case that you require a more thorough and detailed testing than provided by these standard self-test routines.

Test 1 tests most of the computer registers and functions. This test will not alter or destroy the contents of any working register or memory. An error condition will set all display register indicator bits (A, B, M, T, P, S) and the overflow register. The execution time is negligible.

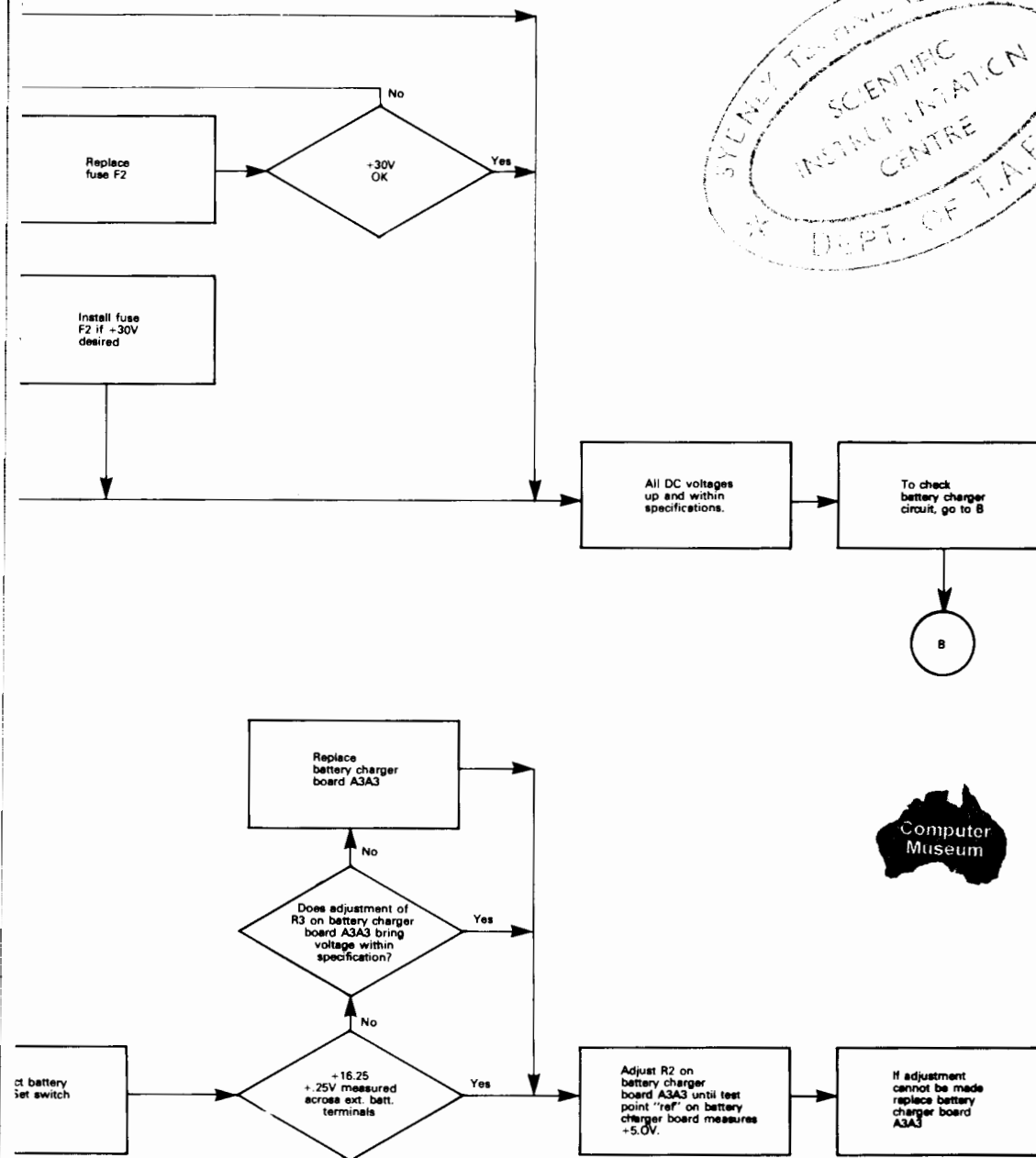
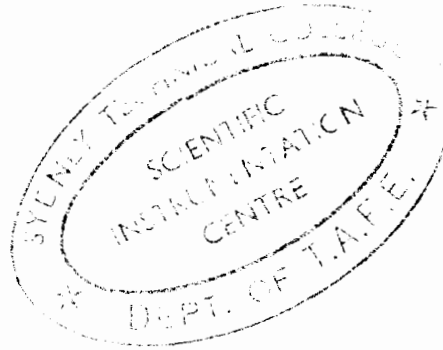
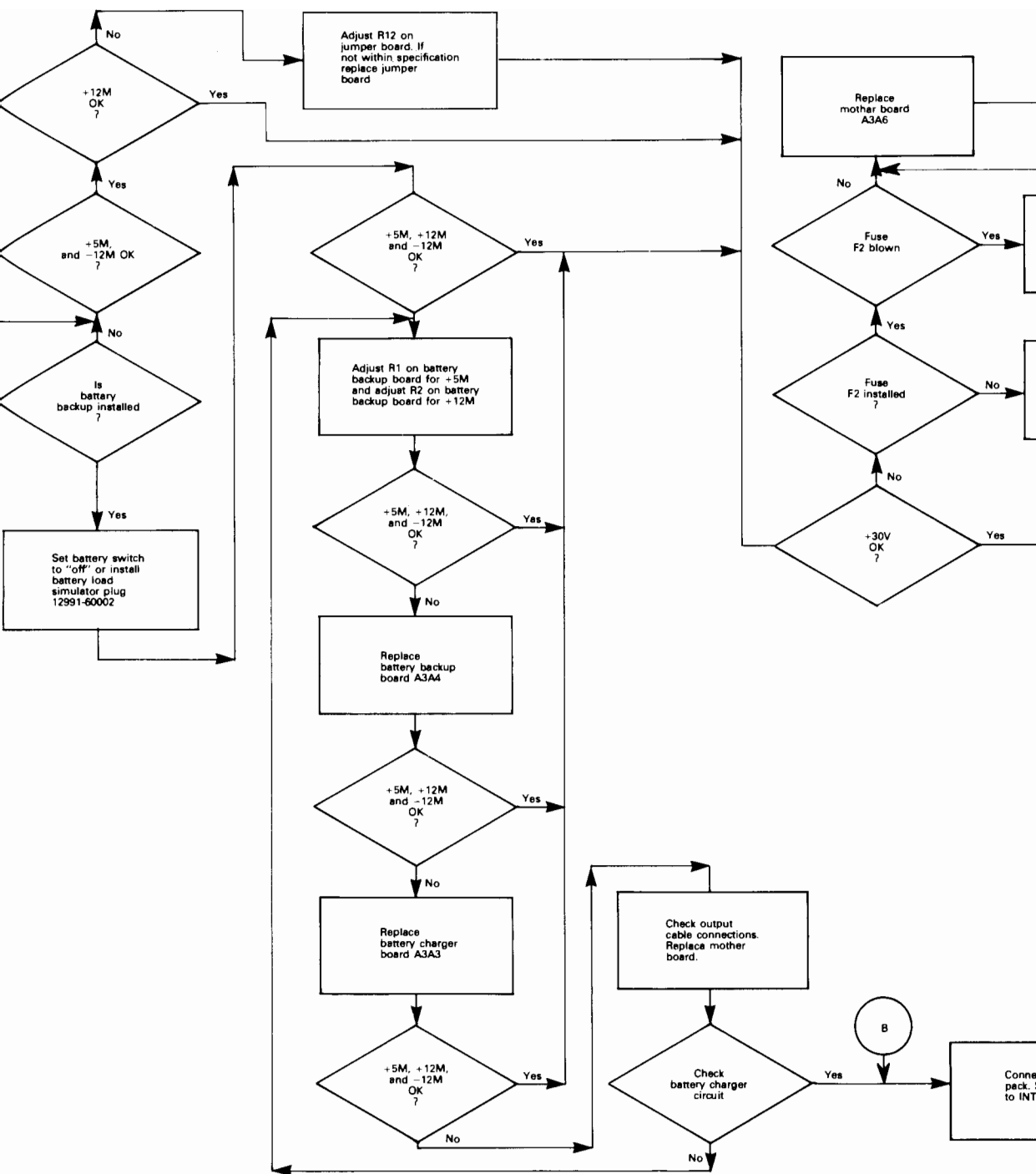
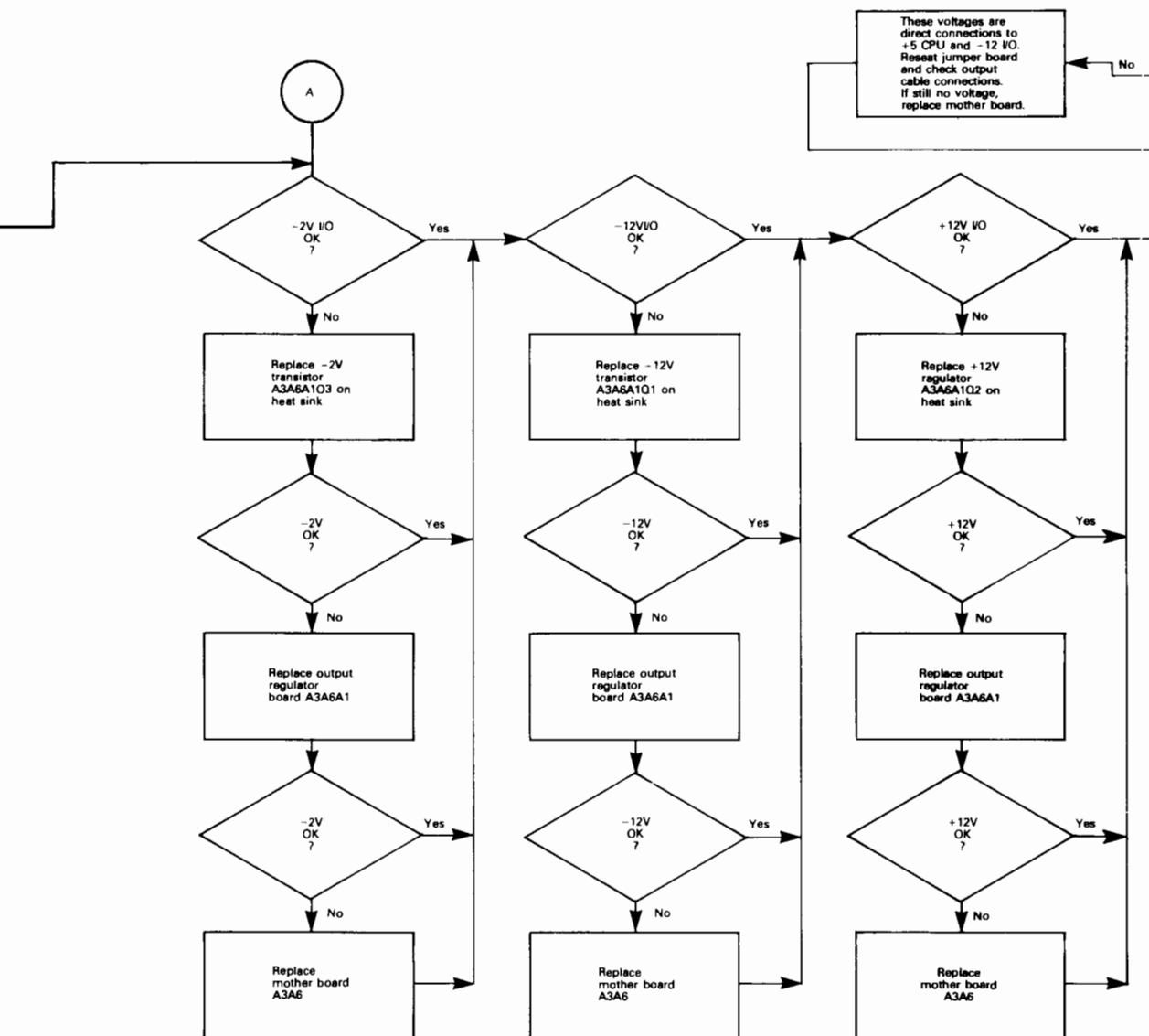


Figure 2-1. Troubleshooting Flowchart (Sheet 1 of 4)
Main Power Supply Operation



Yes
Excessive inrush current.
Check for shorted DC output
voltage, or internal power
supply short, replace CB1
if necessary.



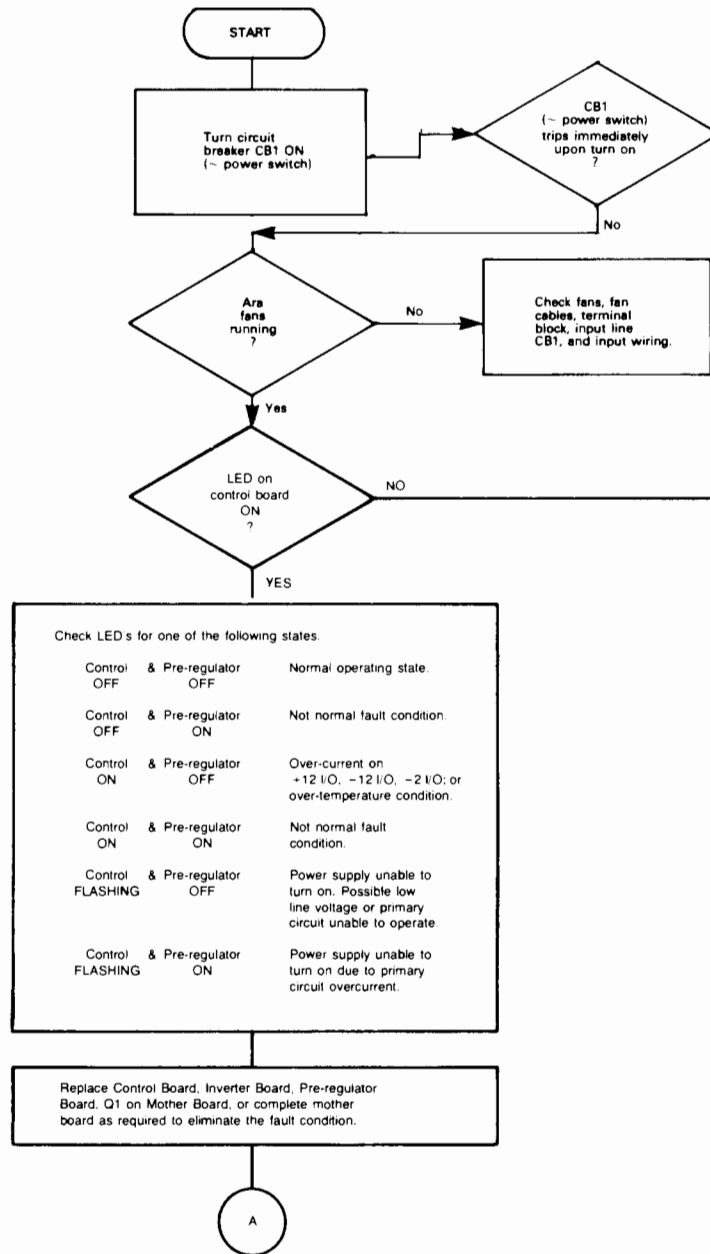
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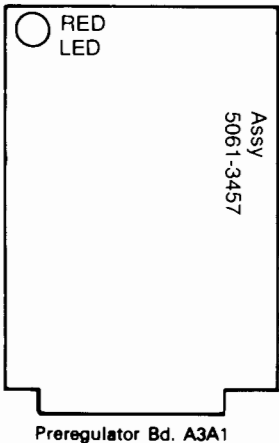
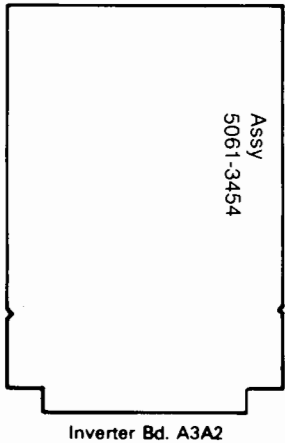
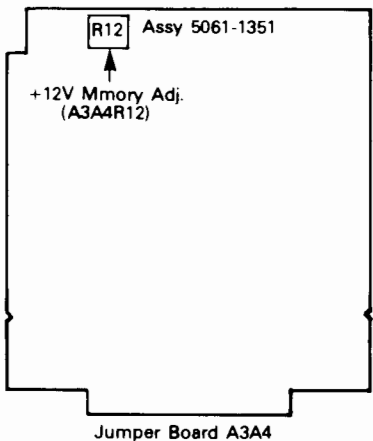
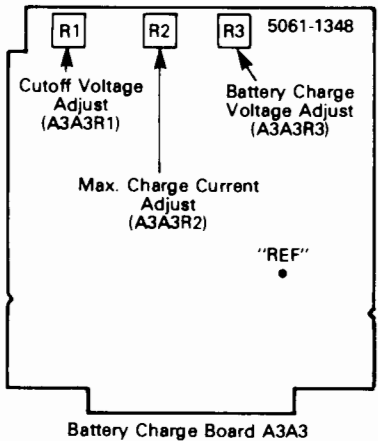
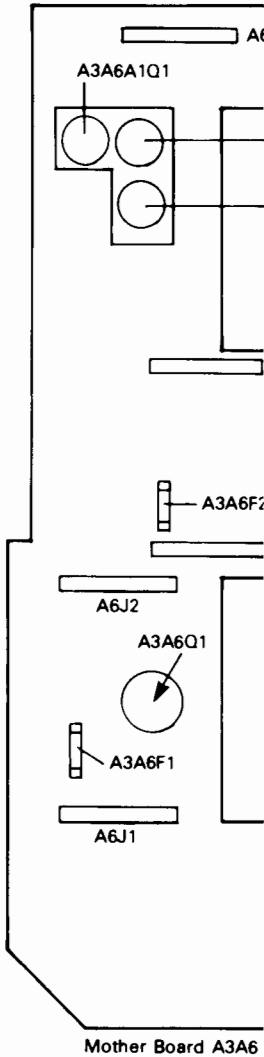
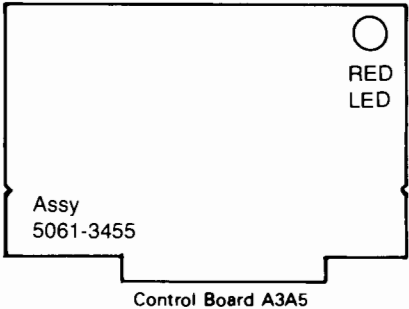
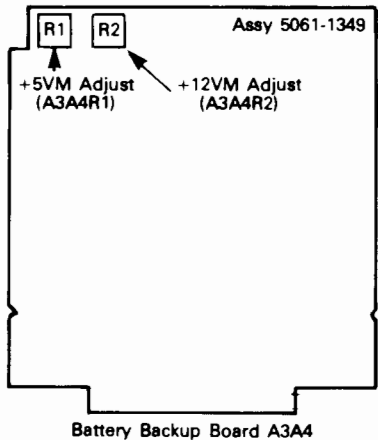
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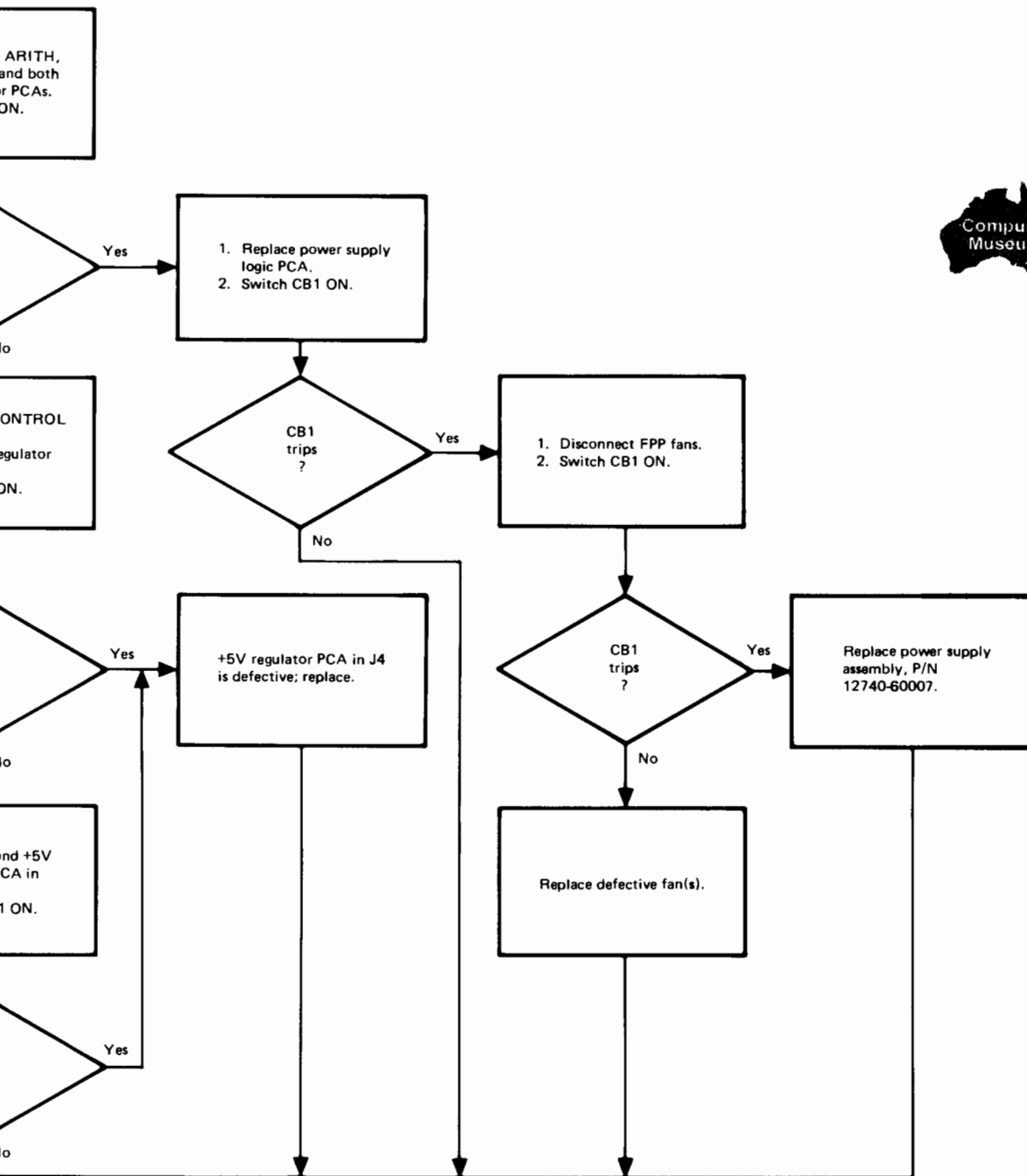
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PARTS LOCATION FOR THE POWER SUPPLY

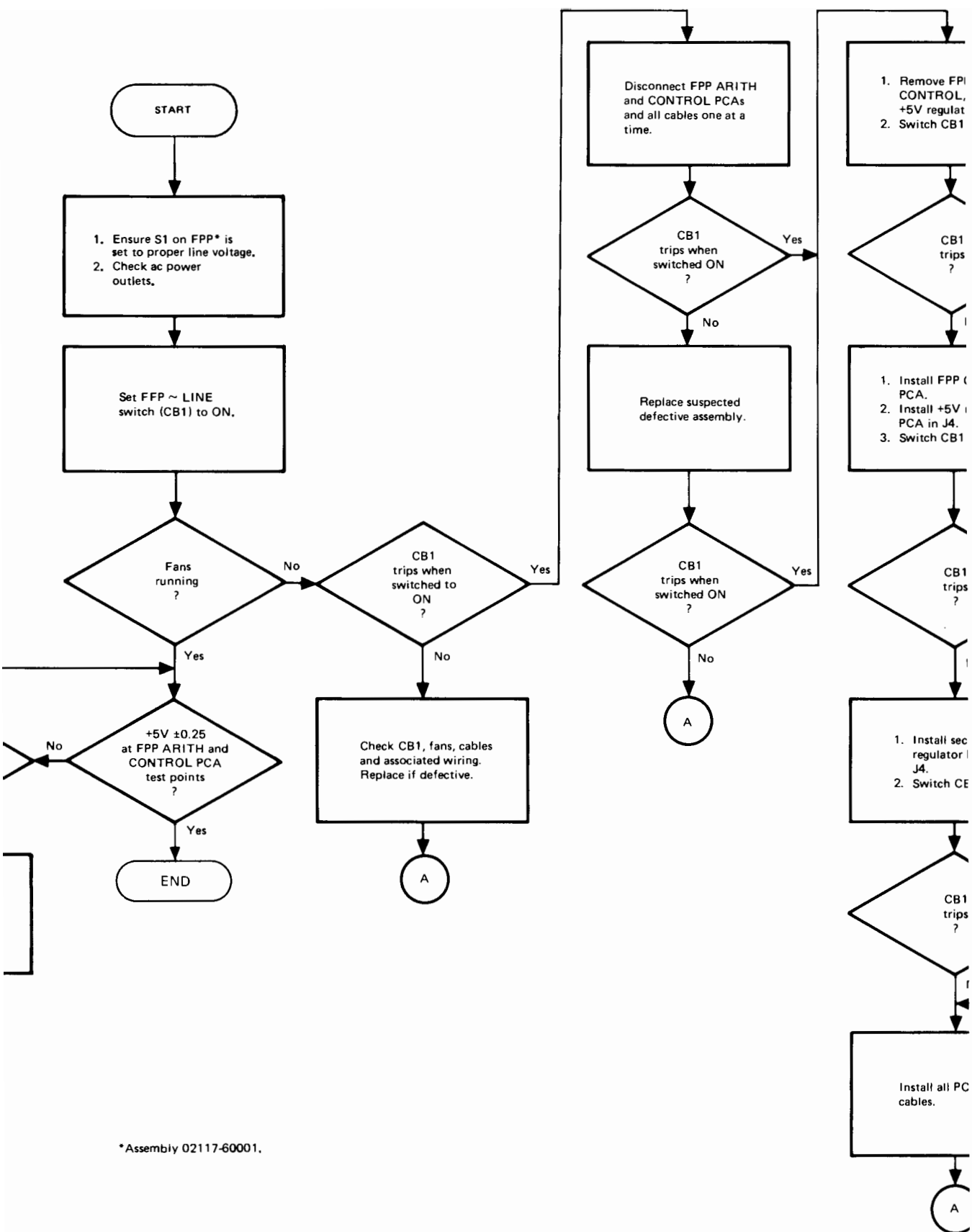


Description	New Part #	
Preregulator BD, A3A1	5061-3457	Power Supply A3 5061-3476
Inverter Bd, A3A2	5061-3454	
Jumper Bd, A3A4	5061-1351	
Control Bd, A3A5	5061-3455	
Mother Bd, A3A6	5061-1371	
Output Regulator Bd, A3A6A1 (Mother Bd subassembly)	5061-3403	
A3A6A1Q3-2V I/O Transistor	1854-0063	Power Fail 12991B
A3A6A1Q1-12V I/O Transistor	1854-0611	
A3A6A1Q2 +12V Regulator	1813-0093	
Battery Charge Bd, A3A3	5061-1348	
Battery Backup Bd, A3A4	5061-1349	

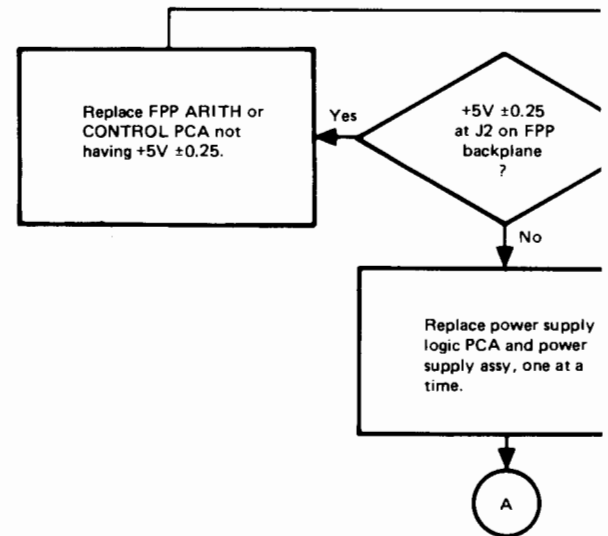
**WARNING**

Hazardous voltages are present inside the power supply.
Remove power cord before removing or installing any
PCA or cable.

Figure 2-1. Troubleshooting Flowchart (Sheet 2 of 4)
2117F Floating Point Processor Power Supply



*Assembly 02117-60001.



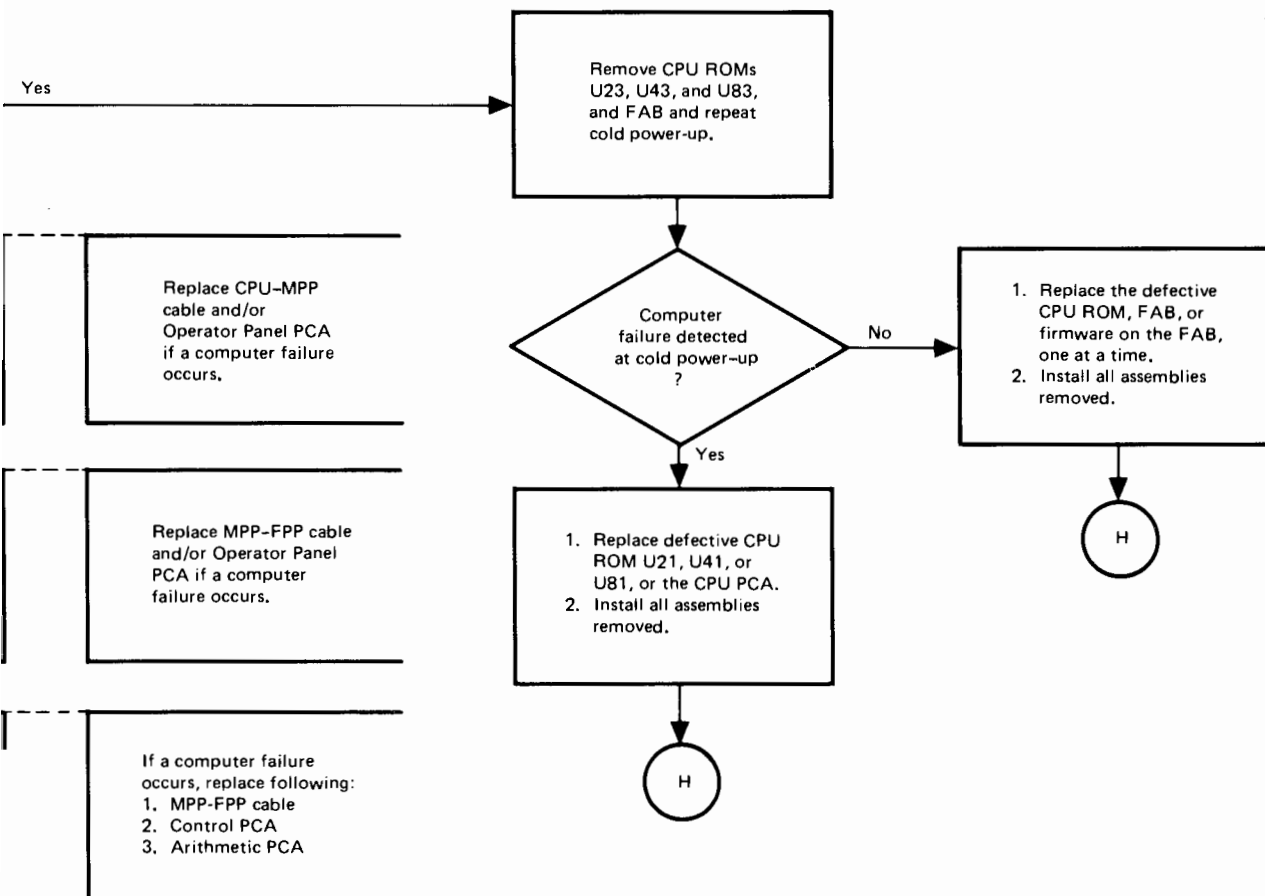
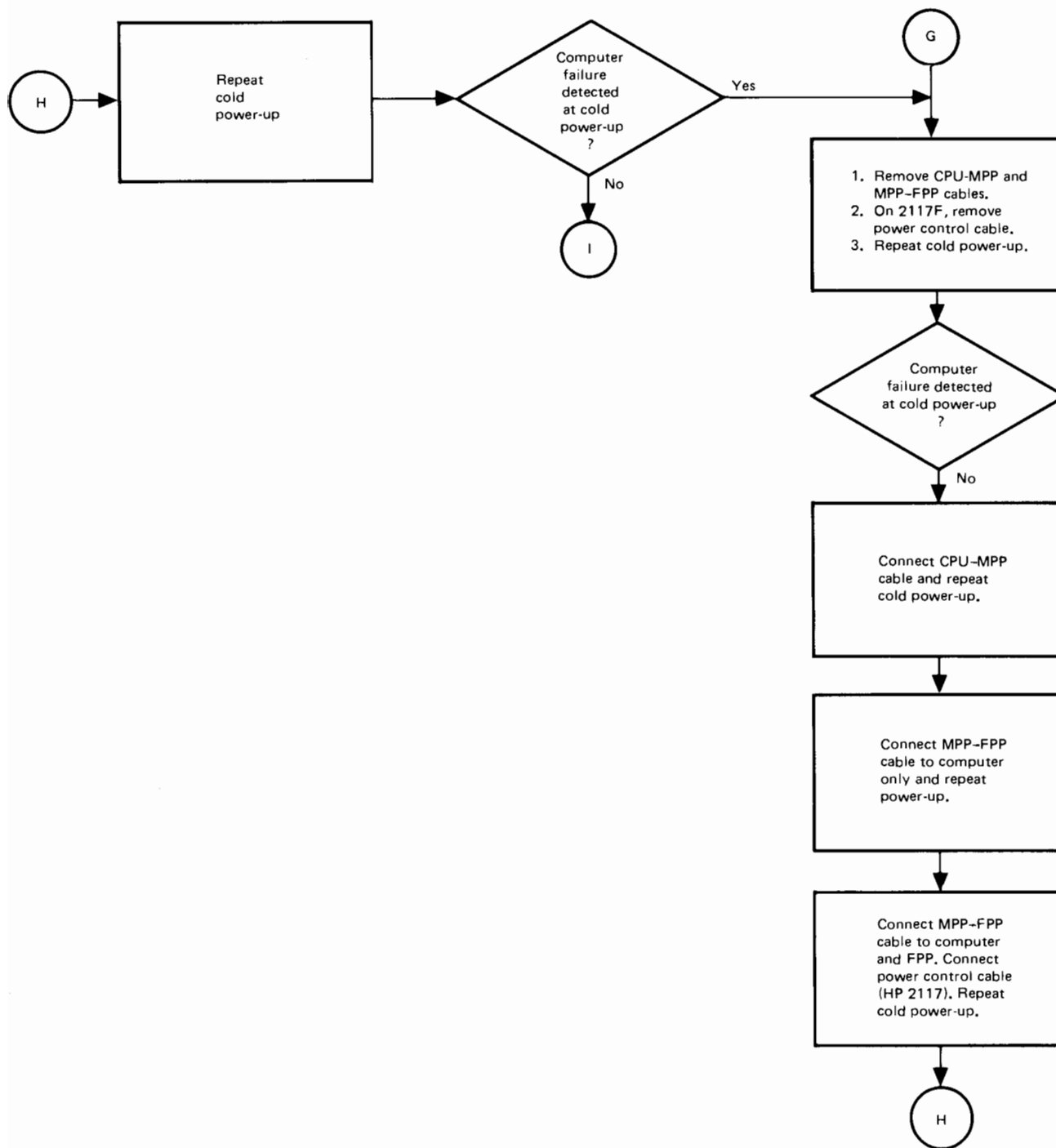
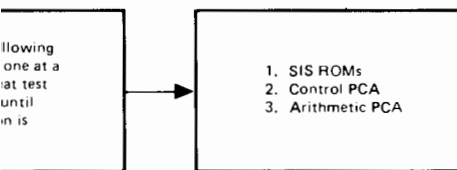
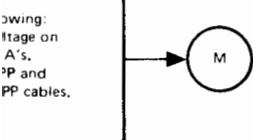
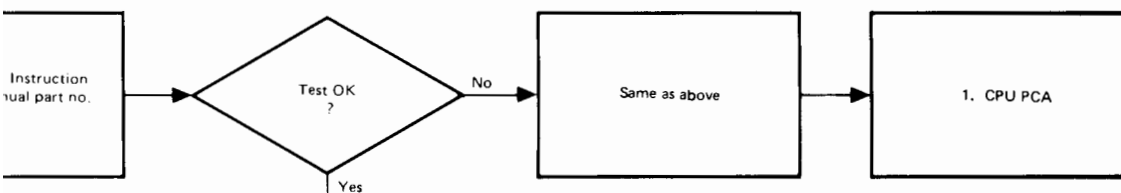
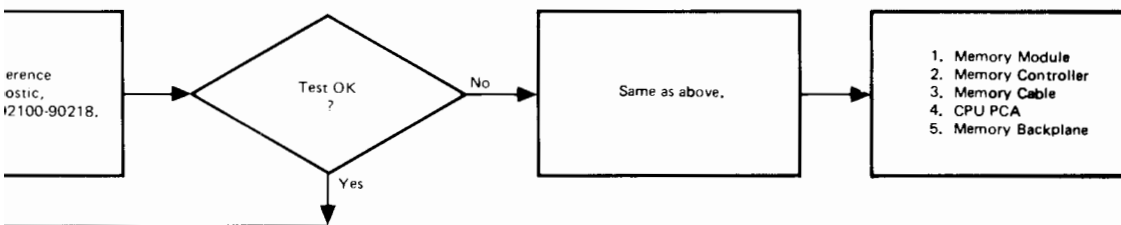
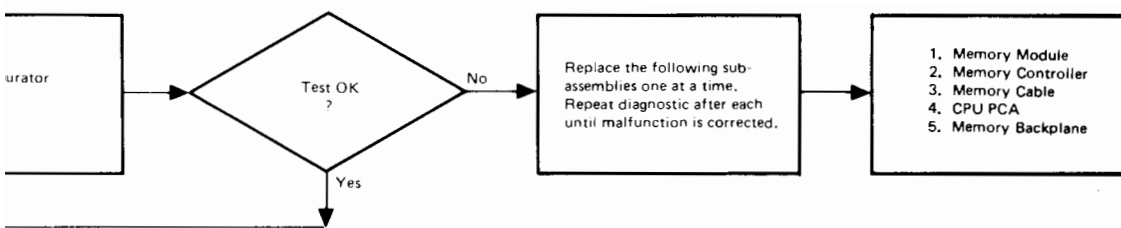
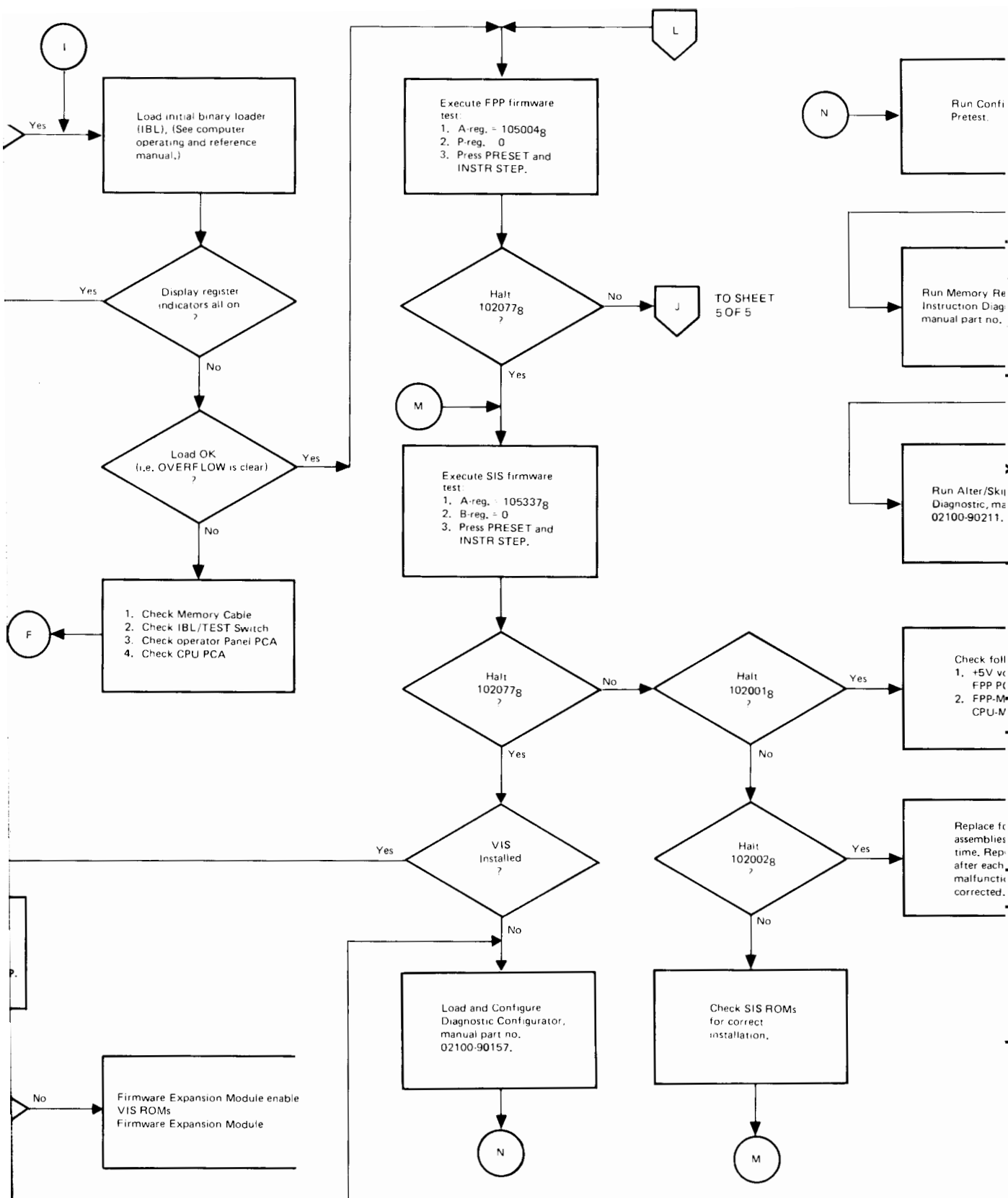
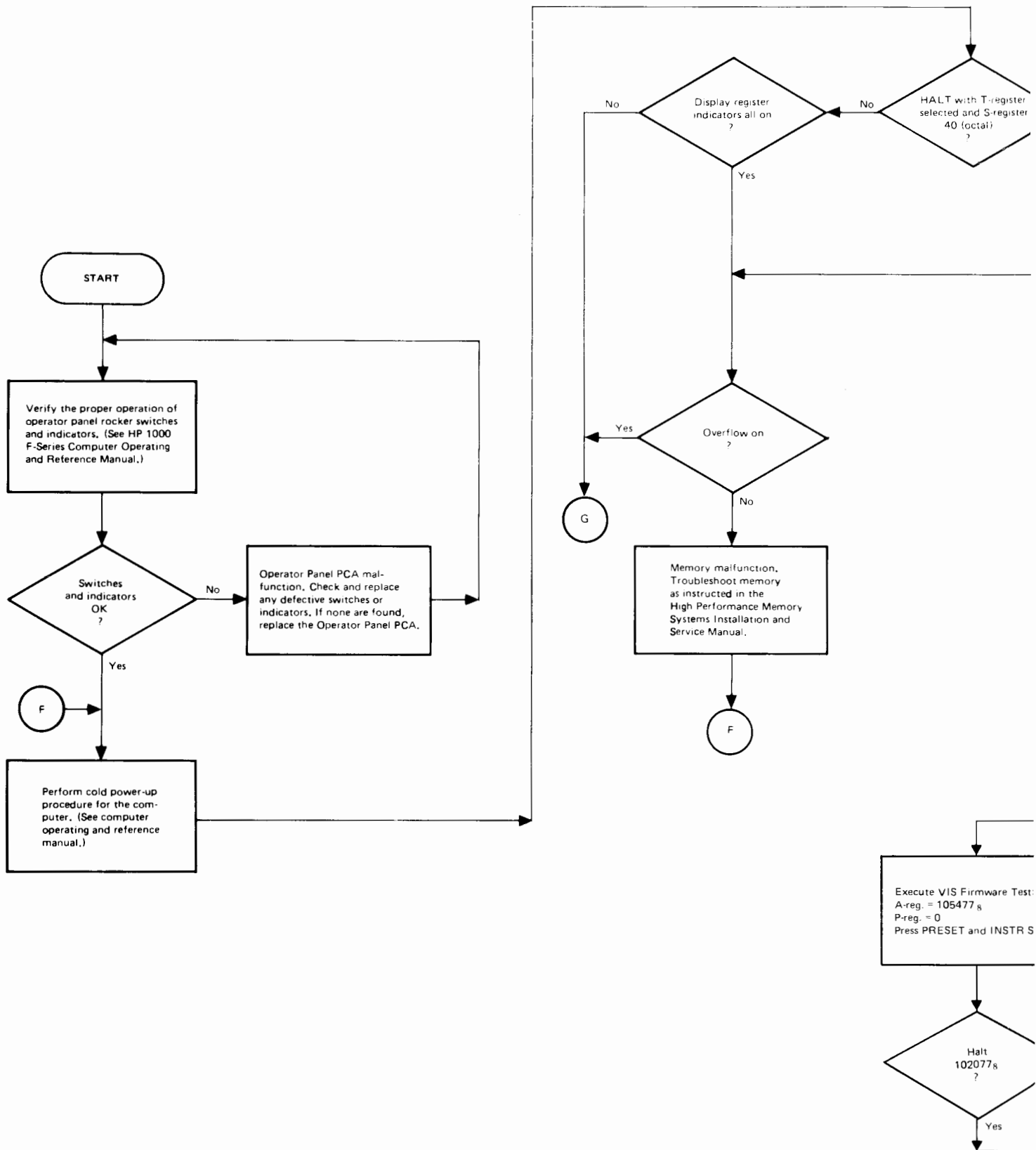


Figure 2-1. Troubleshooting Flowchart (Sheet 3 of 4)
Computer Operation









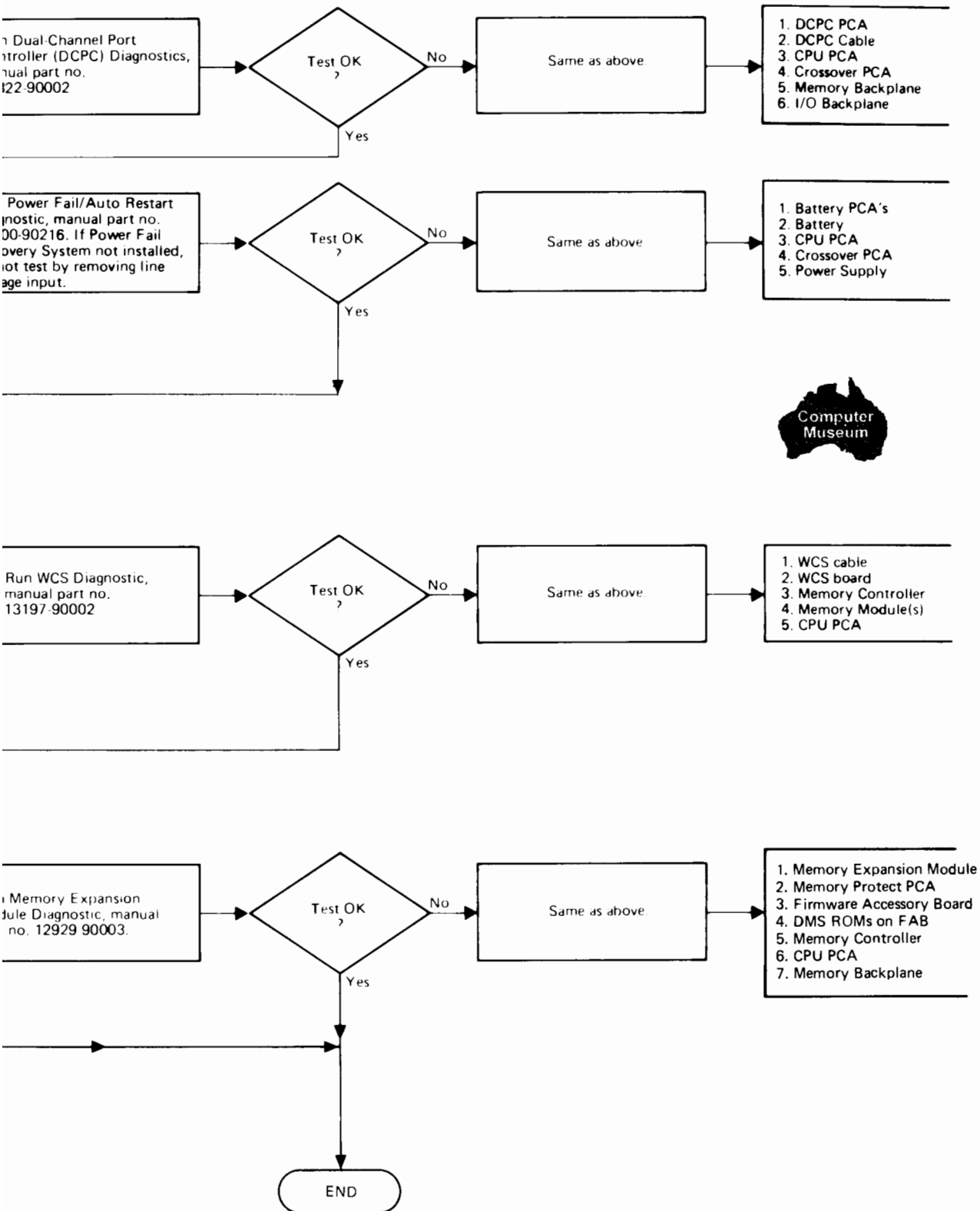
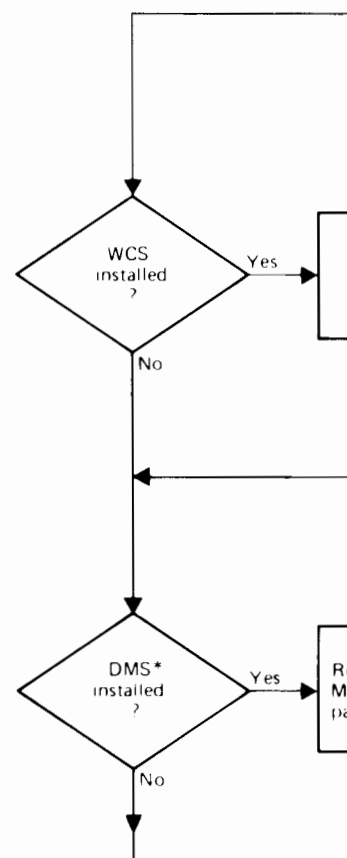
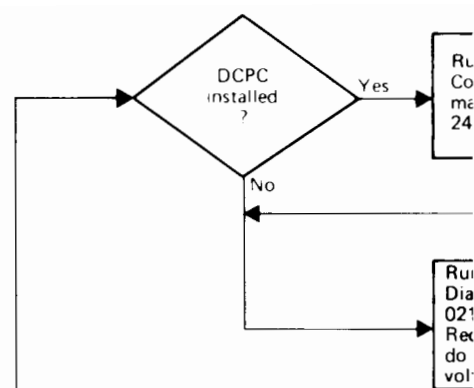
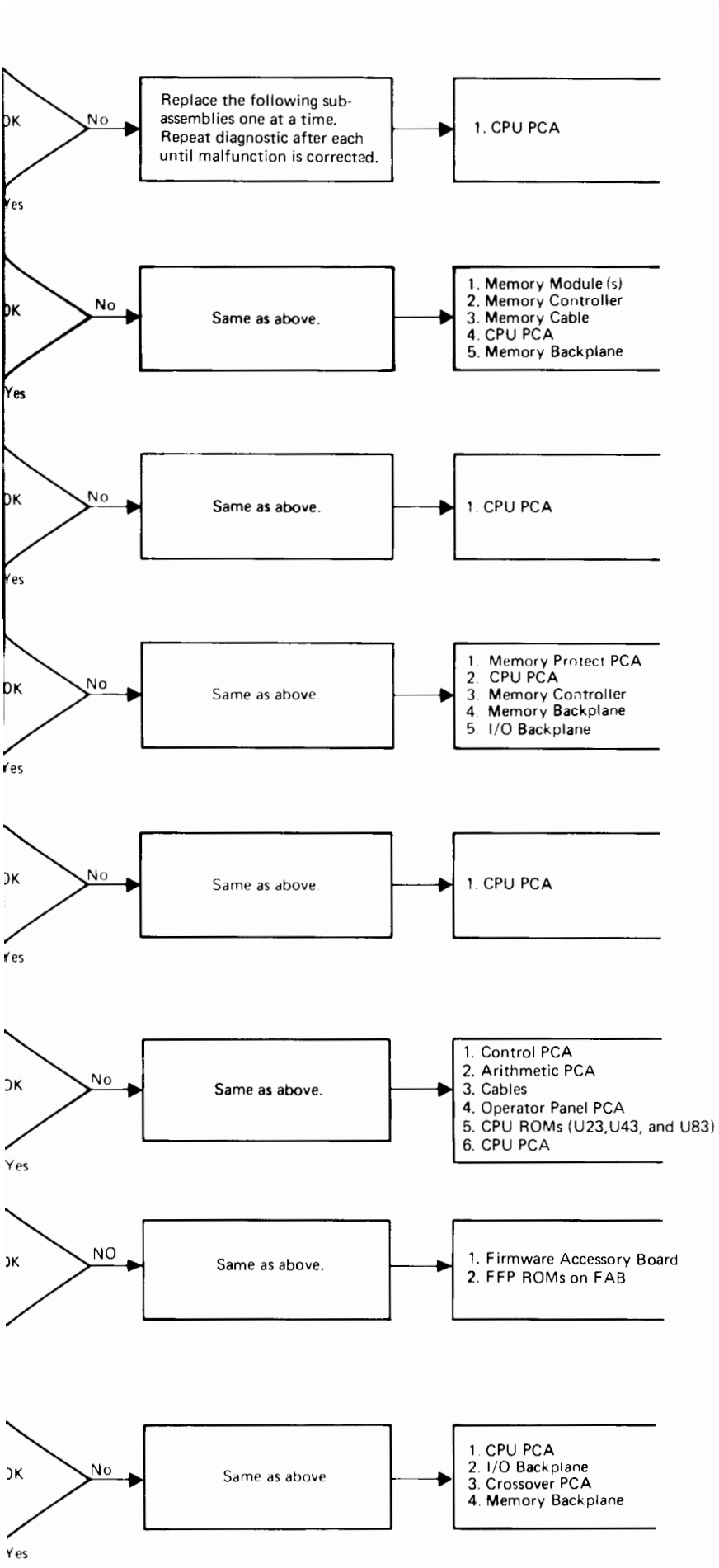
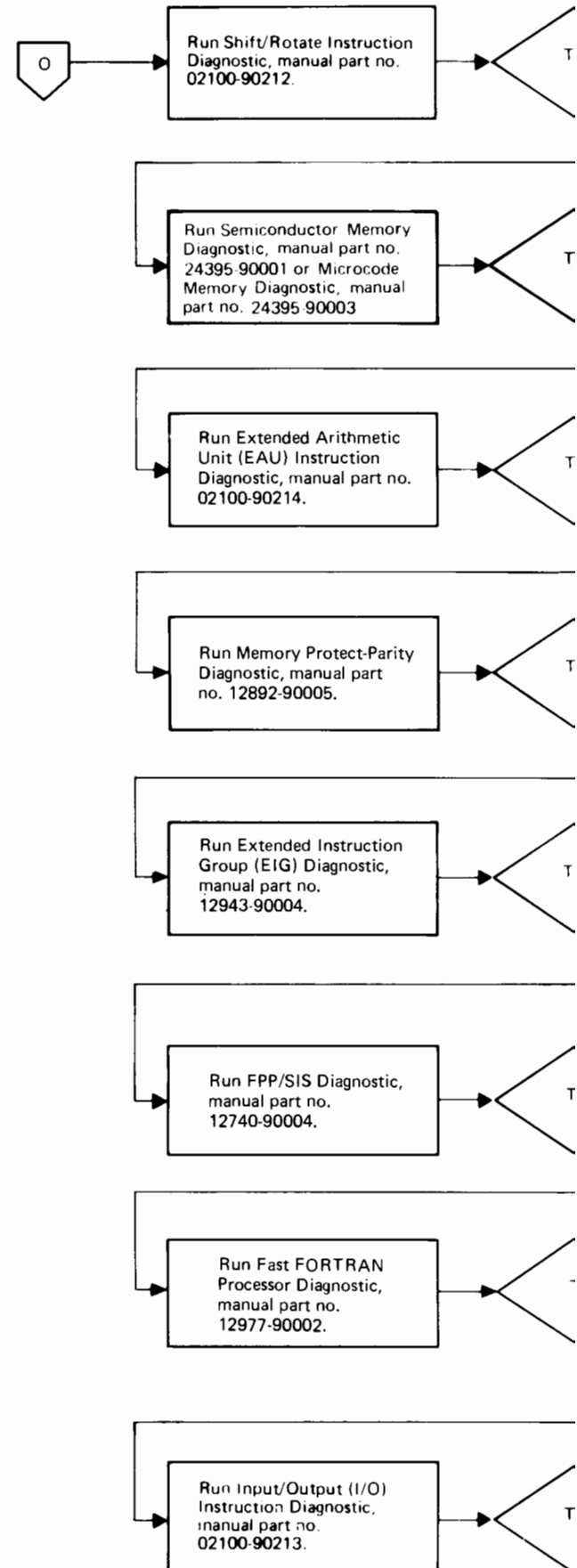
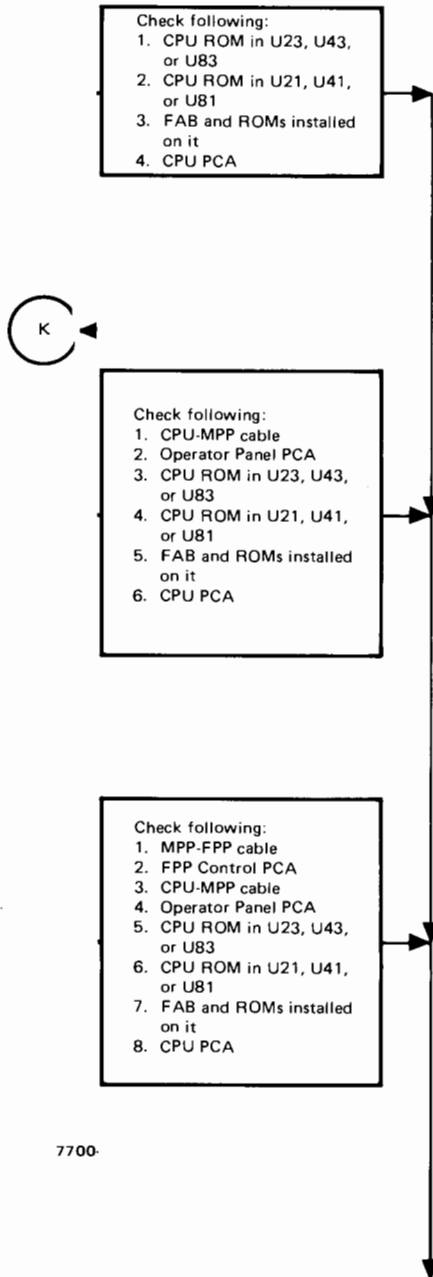
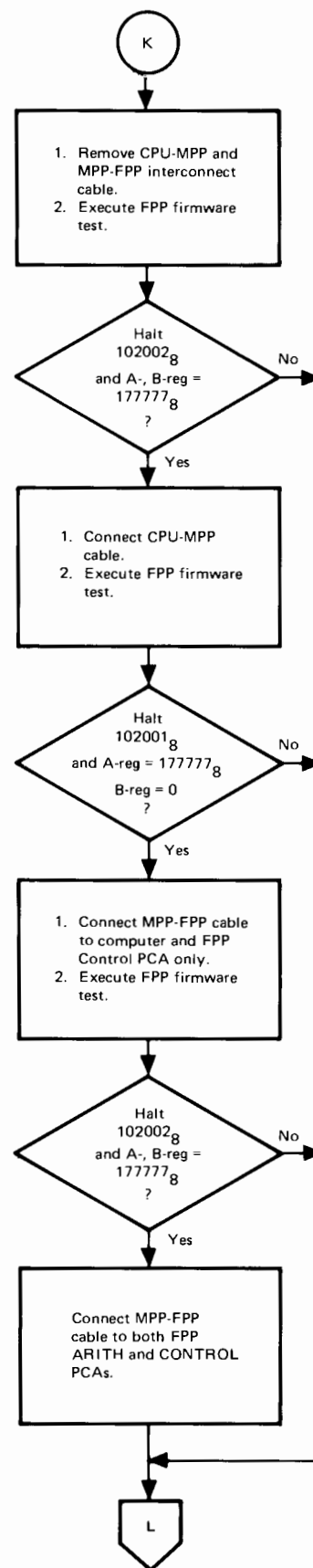
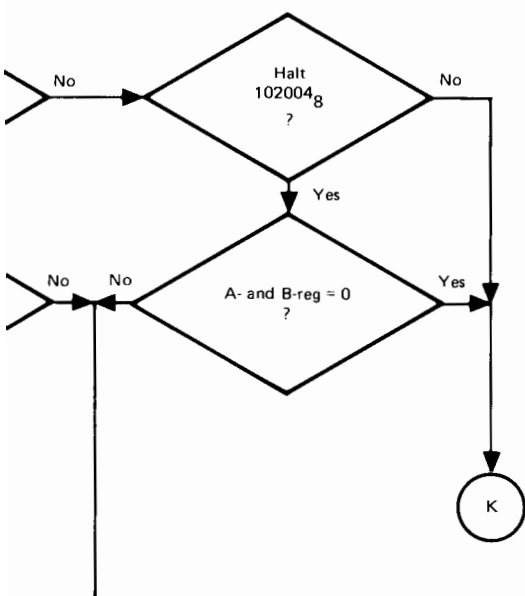


Figure 2-1. Troubleshooting Flowchart (Sheet 4 of 4)
Computer Operation

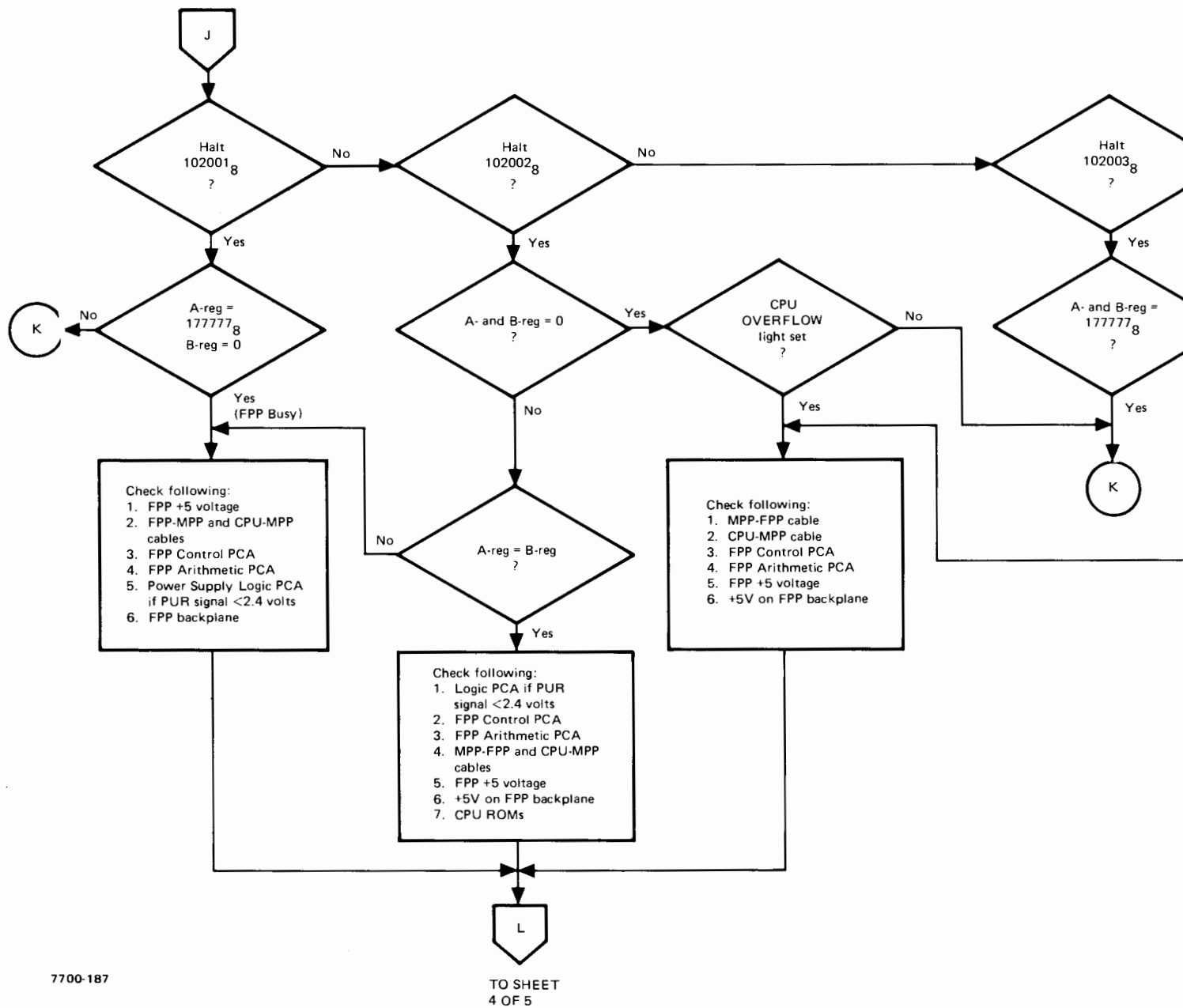


* HP 13305A Dynamic Mapping System





TO SHEET
4 OF 5



Test 2 is a fast microprogrammed memory test that checks the presently enabled memory space (up to 32k words). The microprogram reads each memory location, complements the data and writes it back, reads it, compares it to expected data, then complements it and writes it back into memory. The execution time is negligible and is non-destructive to memory data. An error condition is usually accompanied by a parity error indication and will set all display register indicator bits and clear the overflow register. The A-register will contain the expected (good) data, the B-register will contain the actual (bad) data, and the M-register will contain the logical memory location of the failure.

Test 3 is a significantly more sophisticated microprogrammed memory test. All memory installed in the computer will be tested. Execution time is dependent on the amount of memory installed; approximately one second per 32k words. The display register will increment as each 32k words of memory are tested. Error reporting is the same as in Test 2 except the S-register will contain the number of the 32k words where the memory failure occurred.

On a cold power-up (as described below), Tests 1 and 3 will each be executed once. Pressing the IBL/TEST switch on the operator panel will not only perform the loader function, it will also cause the execution of Tests 1 and 2.

Executing the octal instruction 100000 via the INSTR STEP switch on the operator panel with the LOCK/OPERATE switch in the OPERATE position will execute Tests 1 and 3 once. The information contained in the S-register (when selected) will be the final background pattern used to test memory. This may also be used to easily load the entire memory with the same bit pattern. While the tests are executing, the LOCK/OPERATE switch may be set to the LOCK position and the microprogrammed self-tests will loop continuously until the LOCK/OPERATE switch is returned to the OPERATE position. A memory failure, of course, will terminate the test and report the error.

To check most computer registers and functions and all physical memory, perform the cold power-up procedure as follows:

- Set ~POWER switch to OFF. If computer is equipped with an optional power fail recovery system, set BATTERY switch to OFF. On the HP 2117F set the Floating Point Processor ~LINE switch to ON.
- Set the LOCK/OPERATE switch to OPERATE. Wait approximately six seconds and then set ~POWER switch to ON.
- Set BATTERY switch to INT.
- The self-test will begin execution and the Display Register can be observed incrementing if a dynamic mapping system (DMS) is installed.

- Upon successful completion, the T-register will automatically be selected for display.
- If a computer failure is detected, the Display Register, all six working register indicators (A, B, M, T, P, S), and the OVERFLOW indicator are lighted. Troubleshoot computer failure by performing the procedure presented in figure 2-1.
- If a memory failure is detected, the Display Register, and all six working register indicators (A, B, M, T, P, S) are lighted and the OVERFLOW indicator is not lighted. The PARITY indicator is lighted for odd number of bit failures and not lighted for even number of bit failures. The S-register will contain the octal number of the 64k byte space where the memory failure occurred. To isolate the memory failure, perform the following:
 - Select the M-register which contains the logical memory location of the failure.
 - Select the A-register which contains the expected (good) data.
 - Select the B-register which contains the actual (bad) data.
 - Compare bit by bit the A-register with the B-register to isolate the bad bit(s).
 - Locate the bad bit(s) in figures of Memory System manual, replace memory integrated circuit(s) as described in paragraph 2-49.

Figure 2-2 provides an example and reference information to aid in isolating memory failures on a memory module. If further testing is required or if the firmware diagnostic is unable to locate the memory failure, use the software diagnostic procedure described in paragraph 2-5. For additional reference information refer to the appropriate Memory Systems Installation and Service manual for the memory system in your computer. See Documentation Map on page iv.

2-9. FLOATING POINT. The F-Series computer includes a firmware self-test for testing the floating point PCA's. This self-test detects obvious trouble symptoms but is not intended as a substitute for the more comprehensive software diagnostic. (The self-test can only be executed in the single-step front panel mode; if entered in the run-mode, NOP is performed.) To execute the firmware self-test, proceed as follows:

- Store 105004 (octal) in the A-register.
- Store 0 in the P-register and press PRESET. If the OVFL light remains on, check that the FPP-MPP cable is installed correctly (not twisted). Otherwise, a defective CPU, floating point PCA, or FPP is indicated. Use software diagnostics for further troubleshooting.

S-REGISTER* BITS 2:0	MEMORY MODULE NUMBERS**
000	0, 1, 2, 3
001	4, 5, 6, 7
010	8, 9, 10, 11
011	12, 13, 14, 15
100	16, 17, 18, 19
101	20, 21, 22, 23
110	24, 25, 26, 27
111	28, 29, 30, 31

*S-register will be zero if DMS is not installed in computer.
**Each module number represents 16K bytes of memory.

In the example shown in the shaded areas, the computer halts on a cold power-up with the register "dots" lighted and 000003 (octal) in the S-register. This signifies that a memory failure has occurred somewhere in the fourth contiguous 64k byte block of memory in memory module number 12, 13, 14, or 15.

The M-register is now selected and displays some value between 34000 and 35777 (octal). Examining the memory module column shows that the module number 13 matches one of the module numbers identified by the S-register. If module number 13 is a 16k byte memory board, the failing address is in the second 8k byte segment of that board; if module number 13 is a 32k byte memory board, the failing address is in the fourth 8k byte segment of the board; and if module number 13 is a 128k byte memory board, then the failing address is in the third 32k byte segment of that board.

Now the A-register is selected and its octal contents noted as shown below. (The A-register will always contain the expected or good data.)

Next, the B-register is selected and its contents noted as shown below. (The B-register will always contain the actual data which in this case is faulty data.)

Finally, a bit-by-bit comparison is made and indicates that bit 9 in the B-register is a logical "1" instead of a logical "0". After module number 13 is identified by the jumper configurations shown in figures 2-5 through 2-10, the failing chip associated with bit 9 on that memory module or the memory module may be replaced.

If more than 128k bytes of memory are used, this cycle must be repeated for each 128k byte section.

M-REGISTER ADDRESS (OCTAL)	MEMORY MODULE NUMBERS	16k BYTES MM (8k BYTES)	32k BYTES MM (8k BYTES)	128k BYTES MM (32k BYTES)
00000 to 07777	0, 8, 16, 24	Row 1 (1st 8k bytes)	Row 1 (1st 8k bytes)	Row 1 (1st 32k bytes)
10000 to 17777		Row 2 (2nd 8k bytes)	Row 2 (2nd 8k bytes)	
20000 to 27777	1, 9, 17, 25	Row 1 (1st 8k bytes)	Row 3 (3rd 8k bytes)	
30000 to 37777		Row 2 (2nd 8k bytes)	Row 4 (4th 8k bytes)	
40000 to 47777	2, 10, 18, 26	Row 1 (1st 8k bytes)	Row 1 (1st 8k bytes)	Row 2 (2nd 32k bytes)
50000 to 57777		Row 2 (2nd 8k bytes)	Row 2 (2nd 8k bytes)	
60000 to 67777	3, 11, 19, 27	Row 1 (1st 8k bytes)	Row 3 (3rd 8k bytes)	
70000 to 77777		Row 2 (2nd 8k bytes)	Row 4 (4th 8k bytes)	
00000 to 10000	4, 12, 20, 28	Row 1 (1st 8k bytes)	Row 1 (1st 8k bytes)	Row 3 (3rd 32k bytes)
10000 to 17777		Row 2 (2nd 8k bytes)	Row 2 (2nd 8k bytes)	
20000 to 27777	5, 13, 21, 29	Row 1 (1st 8k bytes)	Row 3 (3rd 8k bytes)	
30000 to 37777		Row 2 (2nd 8k bytes)	Row 4 (4th 8k bytes)	
40000 to 47777	6, 14, 22, 30	Row 1 (1st 8k bytes)	Row 1 (1st 8k bytes)	Row 4 (4th 32k bytes)
50000 to 57777		Row 2 (2nd 8k bytes)	Row 2 (2nd 8k bytes)	
60000 to 67777	7, 15, 23, 31	Row 1 (1st 8k bytes)	Row 3 (3rd 8k bytes)	
70000 to 77777		Row 2 (2nd 8k bytes)	Row 4 (4th 8k bytes)	

A-REGISTER (EXPECTED DATA)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	1	1	1	0	0	0	1	1	0	1	1	1	0	0	1

B-REGISTER (ACTUAL DATA)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	1	1	1	0	0	1	1	1	0	1	1	1	0	0	1

A-REGISTER (EXPECTED DATA)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	1	1	1	0	0	0	1	1	0	1	1	1	0	0	1

B-REGISTER (ACTUAL DATA)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	1	1	1	0	0	1	1	1	0	1	1	1	0	0	1

Figure 2-2. Typical Memory Chip Malfunction Isolation for Less Than 128k Bytes of Memory

- c. Press INSTR STEP.
- d. A 102077 (octal) in the display register (S) indicates successful completion. If 10200X (octal) is returned in the display register, the firmware test failed and the halt code is interpreted as shown in table 2-2. If the firmware test returns an error halt code, use software diagnostics for further troubleshooting.

2-10. FFP TEST. The F-Series computer includes a firmware self-test. This test detects the obvious trouble symptoms but is not intended to be a substitute for the more comprehensive software diagnostic. To execute the firmware self-test, proceed as follows:

- a. Store 105200 in the A-register.
- b. Press PRESET; then press INSTR STEP.

One of three results should be displayed in the S-register:

- a. S = 102077 Indicates successful completion.
- b. S = 102001 Module 33 defective or missing.
- c. S = 102002 Module 35 defective or missing.

Any other indication in the S-register indicates that FFP is defective or not installed properly. The FFP diagnostic should be performed at this time. The diagnostic operating procedures are contained in the *FFP Diagnostic Reference Manual*, part no. 12977-90002.

2-11. SCIENTIFIC. A firmware self-test is included in the scientific instruction set (SIS) to verify proper installation of the SIS firmware. The self-test can only be executed in the single-step front panel mode. (If entered in the run-mode, a NOP is performed.) To execute the firmware self-test, proceed as follows:

- a. Store 105337 (octal) in the A-register.
- b. Store 0 in the P-register.
- c. Press PRESET; then press INSTR STEP.

One of three results of the test should be displayed in the S-register:

- a. S = 102001 Indicates floating point PCA's not cabled or not powered.
- b. S = 102002 Indicates a numerical error in the diagnostic calculation; defective floating point PCA(s) or ROMs.
- c. S = 102077 Indicates successful completion.

Any other indication in the S-register indicates that the SIS firmware is not properly installed on the firmware accessory board.

Table 2-2. Floating Point Self-Test Error Halts

HALT	PROBABLE PROBLEM
102001	<ul style="list-style-type: none"> a. Power not supplied to floating-point PCA's. b. FPP-MPP cable not properly connected. (See figure 1-11.) c. Floating point CONTROL PCA not installed or not connected properly. d. If A-register not 177777 (octal) and B-register not 0, then floating point ROMs defective.
102002	<ul style="list-style-type: none"> a. If A- and B-registers equal 0 and OVFL lit, then FPP-MPP cable twisted. b. If A and B-registers equal 177777 (octal), then floating point ARITH PCA not connected properly or CPU-MPP cable not connected.
102003	a. FPP or floating point PCA defective.
102004	a. FPP or floating point PCA defective.
XXXXXX	a. If display register does not indicate any of the above halts, either the floating point ROMs are not present, ROMs are defective, or computer is defective.

2-12. VIS. To execute the Vector Instruction Set (VIS) firmware test, proceed as follows:

- a. Store 105477 (octal) in the A-register.
- b. Store 0 in the P-register.
- c. Press PRESET; then press INSTR STEP.



A 102077 (octal) in the display register (S) indicates successful completion. Any other display in the S-register indicates that the VIS firmware test failed and the VIS on-line diagnostic, part no. 12824-16001, should be run. The diagnostic operating procedures are contained in the *VIS User's Manual*, part no. 12824-90001.

2-13. SOFTWARE DIAGNOSTICS

2-14. DIAGNOSTIC REFERENCE MANUALS. The software diagnostics listed below should be used for further testing when one of the firmware self-tests indicates an error halt. Procedures for loading and running the diagnostics are given in the listed diagnostic reference manual, which also includes a list of error and information halts.

DIAGNOSTIC	ABSOLUTE BINARY	MANUALS
Semiconductor Memory	24395-16001	24395-90001
Floating Point Processor (includes Scientific Instruction Set and Fast FORTRAN Processor)	12740-16001	12740-90004
Vector Instruction Set (On-Line)	12824-16001	12824-90001

2-15. SUBASSEMBLY REMOVAL AND REPLACEMENT

WARNING

Hazardous voltages are present inside the computer mainframe. Use extreme care when working around the power supply area. Heed all **WARNING — HAZARDOUS VOLTAGE** labels.

CAUTION

All contents of memory will be lost when the mains (line) and battery voltages are both off. Therefore, before proceeding, ensure that any contents of memory to be saved are stored in another medium for later retrieval.

The following paragraphs, which describe procedures for removing and replacing the various computer and memory system subassemblies shown in figures 3-1 through 3-4 assume that the computer is installed as a freestanding device. If the computer is rack mounted, read the entire subassembly removal procedure and refer to figures 3-1 through 3-4 as appropriate. When it is obvious that the procedure cannot be performed with the computer in the rack, proceed as follows:

- Set BATTERY and ~POWER switches to OFF; disconnect power cord.
- Disconnect all I/O cables, including the I/O extender cable if present.
- On the HP 2117F, switch off the FPP ac power and disconnect the power control cable. Remove the FPP-MPP cable.
- Remove computer from rack.

If rack mounted, the Floating Point Processor (FPP) may be removed as follows:

- Switch off the computer and FPP power and remove the FPP power cord.
- Disconnect the power control cable.
- Remove the FPP front panel by grasping the handle and pulling.
- Disconnect the FPP-MPP cable from the FPP ARITH and CONTROL PCA's and remove the cable.
- Remove the FPP from the rack.

2-16. TOP, SIDE, AND BOTTOM COVERS

WARNING

Hazardous voltages are exposed when the covers are removed and ac power applied.

2-17. REMOVAL. Remove the computer top, side, and bottom covers as follows:

- Loosen screw located in rear fold of top (or bottom) cover. Slide top (or bottom) cover toward rear and remove.
- Remove chassis slide(s), if present. Remove the two screws and washers from center of side cover; slide cover toward rear and remove.
- Remove the Floating Point Processor (FPP) top cover by removing the six screws attaching the top cover to the FPP mainframe.

2-18. REPLACEMENT. Replace covers in the reverse order of the removal procedure.

2-19. FIRMWARE ACCESSORY BOARD

2-20. REMOVAL. Set the ~POWER and BATTERY switches to OFF, remove the bottom cover, and proceed as follows:

- Disconnect the connector assembly from firmware accessory board and CPU PCA.
- Remove the four screws and lockwashers securing firmware accessory board to CPU PCA and remove.

2-21. REPLACEMENT. Replace firmware accessory board in reverse order of the removal procedure.

2-22. CENTRAL PROCESSOR UNIT PCA

2-23. REMOVAL. Set the ~POWER and BATTERY switches to OFF, remove the bottom cover, and proceed as follows:

- Disconnect operator panel cables from CPU PCA front edge connectors. Remove firmware accessory board and connector assembly.
- Remove the 12 screws and lockwashers securing CPU PCA to bottom of computer mainframe.
- Remove the three nuts and six washers from power terminals located in center of CPU PCA. (See figure 2-3.)
- Carefully disengage CPU PCA from memory and I/O backplanes.

2-24. REPLACEMENT. Install CPU PCA in the computer mainframe as follows:

- Carefully insert power terminals in center of CPU PCA as shown in figure 2-3. Secure power terminals to CPU PCA with the three nuts and six washers.

- Position CPU PCA with receptacles A1XA4 and A1XA5 in contact with I/O backplane and memory backplane connectors.
- Press inward on back of A1XA4 and A1XA5 to seat backplanes fully into CPU PCA receptacles.
- Replace the 12 screws and lockwashers securing CPU PCA to bottom of computer mainframe.
- Replace the firmware accessory board and connector assembly, and connect operator panel cables to CPU PCA front edge connectors. Replace bottom cover.
- Set ~POWER switch to ON and BATTERY switch to INT.

2-25. BASE SET INSTRUCTION

2-26. REMOVAL. Refer to the *HP 1000 M/E/F-Series Firmware Installation and Reference Manual*, part no. 12791-90001.

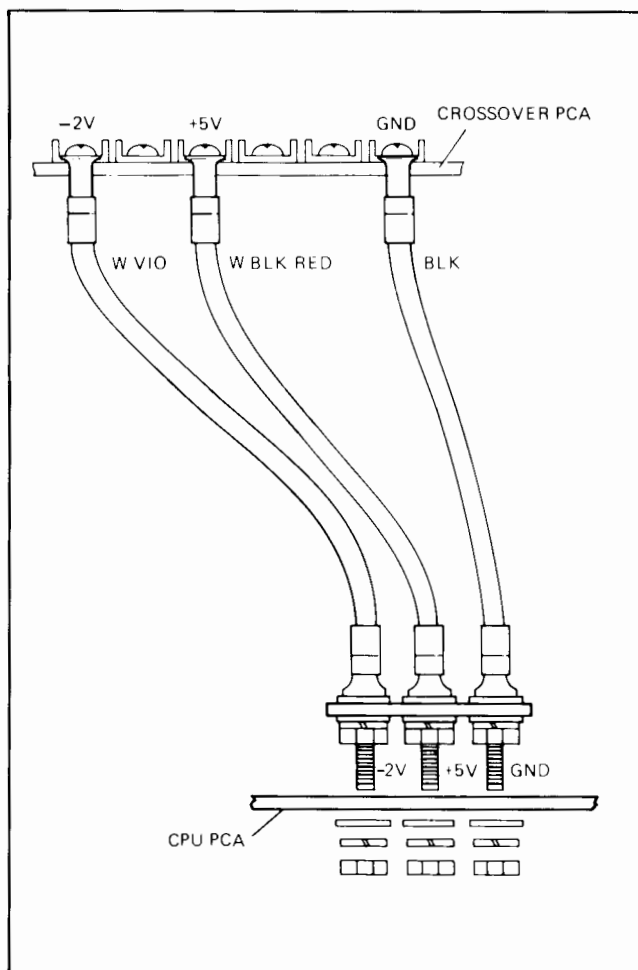


Figure 2-3. CPU Power Connections

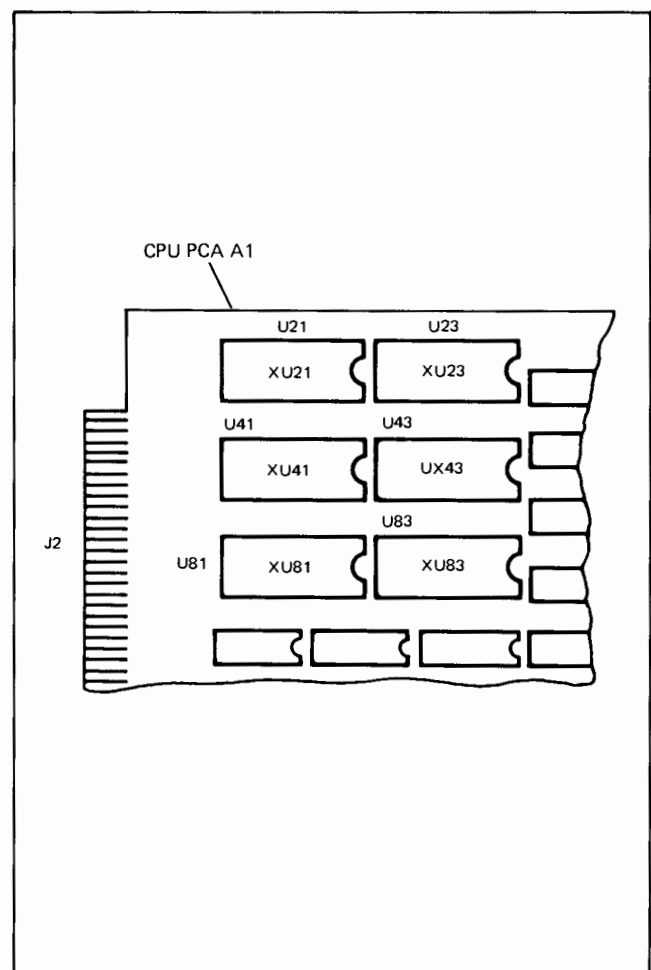


Figure 2-4. Base Set Instruction ROM Locations

CAUTION

ROMs will be permanently damaged if incorrectly oriented when installed and power is applied. See figure 2-4.

2-27. REPLACEMENT. Refer to the *HP 1000 M/E/F-Series Firmware Installation and Reference Manual*, part no. 12791-90001, for current ROM part numbers.

2-28. STANDARD AND OPTIONAL FIRMWARE ROMS

2-29. REMOVAL AND REPLACEMENT. For removal and replacement instructions for the firmware sets listed below, refer to the *HP 1000 E/F-Series Firmware Installation and Reference Manual*, part no. 12791-90001.

- Fast FORTRAN/Double Integer ROMs
- Scientific Instruction Set ROMs
- Extended Memory Area (RTE-IV) ROMs
- Dynamic Mapping Instruction ROMs
- Vector Instruction Set (optional) ROMs
- HP 91740B DS/1000 Distributed System (optional) ROMs

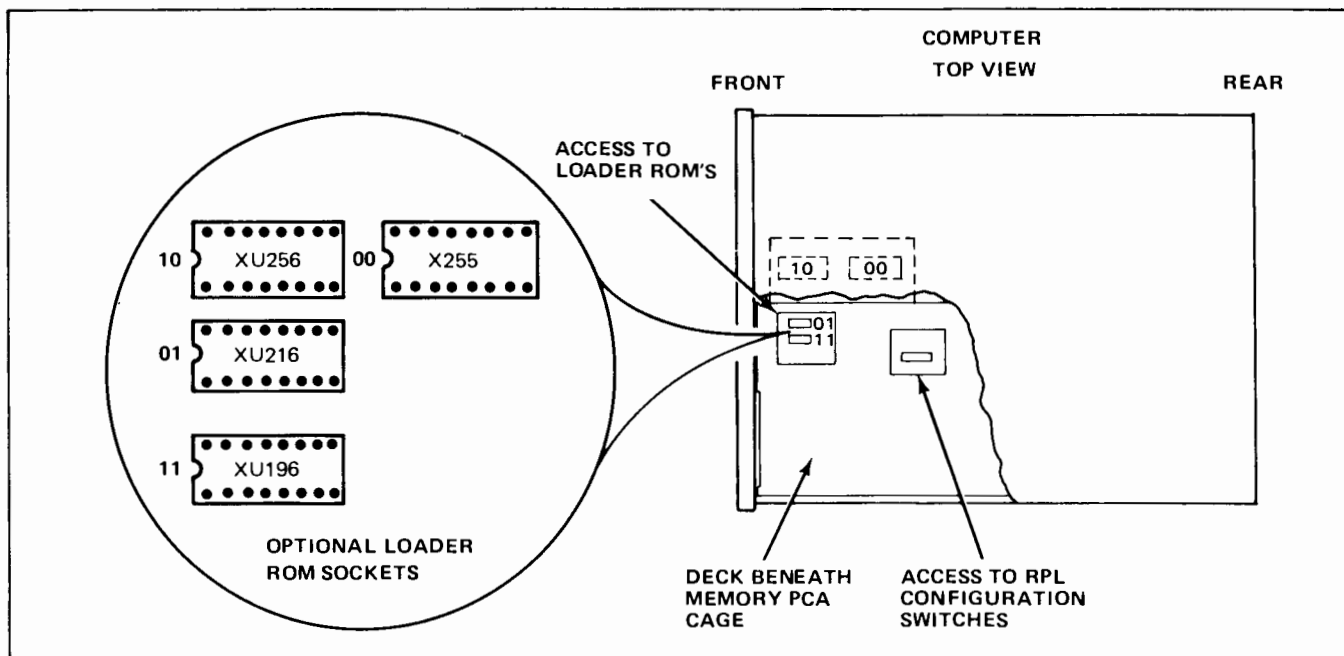
2-30. OPTIONAL LOADER ROMS

Optional loader ROM's, if installed, are mounted in 16-pin IC sockets on the component side of the CPU PCA. (See figure 2-5.) Optional loader ROM's (1 and 3) may be removed or replaced by performing the following:

CAUTION

Optional loader ROM's may be damaged if ac power is present when removing or replacing ROM's.

- Set ~POWER and BATTERY switches to OFF.
- Remove the two screws and lockwashers securing memory PCA cage cover to the memory PCA cage; remove memory PCA cage cover.
- Disconnect cable assembly from all memory PCA's and DCPC cable assembly (if installed) from DCPC PCA.
- Remove enough memory PCA's from the PCA cage by pulling outward on extractor levers to allow access to the loader ROM's.
- At bottom of memory PCA cage, locate opening in deck for the optional loader ROM sockets (01₂ and 11₂). (See figure 2-5.)
- Remove or replace optional loader ROM integrated circuit(s). Ensure that the ROM integrated circuit is oriented with the notched end facing in the same direction as the other integrated circuits on the CPU PCA.



7700-80

Figure 2-5. Optional Loader ROM Sockets

After removing or replacing optional loader ROM, replace all PCA's in memory PCA cage, reconnect cable assemblies, and reinstall memory PCA cage cover and operator panel.

To remove or install ROM's in sockets 10 or 00, it is necessary to remove the CPU PCA.

2-31. OPERATOR PANEL PCA

2-32. REMOVAL. Turn the key clockwise on the operator panel and lower it to the access position.

- a. Disconnect operator panel cable from CPU PCA front edge connector A1J1. Disconnect the two cables from the edge connectors on the operator panel PCA.
- b. Remove the four screws, flatwashers, and lockwashers from operator panel PCA cover; remove operator panel PCA cover.
- c. Remove the seven screws and lockwashers securing operator panel PCA to operator panel; remove operator panel PCA.

2-33. ROCKER SWITCH CONTACTS. Defective rocker switch contacts on the operator panel PCA are replaced as follows:

- a. Remove the plastic material on the circuit side of operator panel PCA securing the rocker switch assembly to the operator panel PCA.
- b. Grasp rocker switch assembly and pull straight out from operator panel PCA.
- c. Separate defective spring contacts from rocker switch assembly.
- d. Clean replacement spring contacts with the Freon TF Degreaser (or equivalent) and position replacement spring contacts onto operator panel PCA.
- e. Using a new rocker switch frame, place the rocker switch assembly over the spring contacts; press inward on the rocker switch assembly until it snaps into place.
- f. Apply a hot soldering iron with a broad tip or a similar device and melt the plastic tip protruding through the circuit side of the PCA to secure the switch assembly in place.

2-34. REPLACEMENT. Install the operator panel PCA as follows:

- a. Carefully place operator panel PCA into position and replace the seven screws and lockwashers.

- b. Place operator panel PCA cover over operator panel PCA and secure in place with the four screws, flatwashers, and lockwashers.
- c. Connect operator panel cable to CPU PCA front edge connector A1J1. Connect the two cables to the operator panel PCA edge connectors (figure 1-11).
- d. Set LOCK/OPERATE switch to OPERATE.
- e. Close operator panel and turn key fully counter clockwise to secure the panel in place.

2-35. I/O INTERFACE PCA'S

2-36. REMOVAL. Remove an I/O interface PCA from the I/O PCA cage as follows:

- a. Turn key clockwise and lower operator panel to access position. Set ~POWER switch to OFF.
- b. If power fail recovery system is installed, set BATTERY switch to OFF and disconnect battery cable from BAT. INPUT connector.
- c. Remove I/O PCA cage cover and loosen the screws securing I/O PCA retainer. Slide retainer to the right.
- d. Remove I/O cable connector hood from I/O interface PCA. Remove I/O interface PCA by pulling outward on the PCA extractor levers.

2-37. REPLACEMENT. Replace I/O interface PCA in reverse order of the removal procedure. Be sure to configure the I/O interface PCA jumpers (if used) if a replacement PCA is being installed.

2-38. FLOATING POINT PCA'S (HP 2111F)

2-39. REMOVAL. Remove a floating point PCA as follows:

- a. Turn key clockwise on operator panel and lower panel to access position. Set ~POWER and BATTERY switches to OFF.
- b. Disconnect the FPP-MPP cable from ARITH and CONTROL PCA's.
- c. Remove PCA by pulling outward on extractor levers.

2-40. REPLACEMENT. Replace the floating point PCA in reverse order of the removal procedure.

NOTE

Due to the power dissipation of the ARITH PCA it is recommended that it be installed in the upper slot of the FP PCA cage.

2-41. FLOATING POINT PCA'S (HP 2117F)

2-42. REMOVAL. Remove the floating point PCA's from the Floating Point Processor (FPP) as follows:

- Switch off the computer and FPP power.
- Remove the FPP front panel by grasping the handle and pulling.
- Disconnect the FPP-MPP cable from FPP ARITH and CONTROL PCA's.
- To remove PCA, pull forward on extractor levers.

2-43. REPLACEMENT. Replace a floating point PCA in reverse order of the removal procedure.

NOTE

Due to the power dissipation of the FPP ARITH PCA it is recommended that it be installed in the upper slot of the FPP PCA cage.

2-44. CROSSOVER PCA

2-45. REMOVAL. Remove the crossover PCA as follows:

- Lower the operator panel to the access position and set the ~POWER switch to the OFF position.
- For the HP 2111F, remove both floating point PCA's.
- Remove the computer top cover.
- Disconnect power supply cable from edge connector J2 of the crossover PCA. (See figure 1-8.) If used, disconnect DCPC cable from edge connector J1.
- Remove the screws securing the DC power cable wires to the crossover PCA.
- Remove the four screws and lockwashers securing crossover PCA to PCA cage covers.
- Carefully lift crossover PCA to free it from I/O and memory backplane edge connectors.

2-46. REPLACEMENT. Install the crossover PCA as follows:

- Position crossover PCA with receptacles A6XA4 and A6XA5 in contact with I/O and memory backplane connectors.
- Press downward on back of A6XA4 and A6XA5 to seat backplanes fully into crossover receptacles. Secure crossover PCA to PCA cage covers using the four screws and lockwashers.

- Connect the DC power cable to the crossover PCA. See figure 1-8 for cable wire identification colors.
- Connect power supply cable to edge connector J2. Connect DCPC cable (if used) to J1.
- For HP 2111F, install floating point PCA's.
- Replace computer top cover and set ~POWER switch to ON and BATTERY switch to INT. Close operator panel

2-47. MEMORY AND I/O BACKPLANES

2-48. REMOVAL. Remove the memory and I/O backplanes from the computer mainframe as follows:

- Set ~POWER and BATTERY switches to OFF.
- Remove top cover and disconnect DCPC cable assembly (if used) from crossover PCA edge connector J1.
- Withdraw all memory PCA's approximately 5 cm (2 inches) to clear rear connectors from memory backplane receptacles.
- Withdraw all I/O interface PCA's approximately 5 cm (2 inches) to clear rear connectors from I/O backplane receptacles.
- Remove the four screws and lockwashers securing crossover PCA to PCA cage covers. Carefully lift crossover PCA to free it from backplane edge connectors.
- Grasp memory backplane and lift up and out of memory PCA cage assembly.
- Grasp I/O backplane and lift up and out of I/O PCA cage assembly.

2-49. REPLACEMENT. Replace the memory and I/O backplanes in reverse order of the removal procedure. Be sure to reconnect DCPC cable assembly (if used) after all PCA's have been seated firmly into their mating receptacles.

CAUTION

Note markings on backplanes to ensure proper orientation. Improper orientation can damage the computer.

2-50. COMPUTER POWER SUPPLY**WARNING**

Hazardous voltages are present with the ac power cord connected. Ensure that ac power cord is disconnected before proceeding.

2-51. REMOVAL. Proceed as follows:

- a. Turn the key in the operator panel clockwise and lower the operator panel to the access position.
- b. Disconnect the two connector's from the front of the power supply.
- c. Unfasten the two clips holding the power supply at the front by pushing them towards the center line of the power supply.
- d. If a power recovery system is installed, set the BATTERY switch to OFF and disconnect the battery cable from the BAT INPUT connector. Loosen the two screws holding the I/O PCA retainer and slide the retainer to the right.
- e. Remove the two screws and lockwashers located at the bottom of the rear panel of the power supply securing the power supply to the rear frame of the computer.
- f. Slide the power supply out from the computer about 50 mm (2 in.) and stop. The two fan cables for the top fans must be disconnected before proceeding.
Grasp the connector and squeeze the latching sides to free the connector. Do this for both connectors.
- g. Slide the power supply out and remove it from the computer.

2-52. REPLACEMENT. Replace the power supply in the reverse order of the removal procedure.**2-53. COMPUTER POWER SUPPLY VENTILATING FANS****2-54. REMOVAL.** Remove the computer top cover and proceed as follows:**WARNING**

Hazardous voltages are present with the ac power cord connected. Ensure that ac power cord is disconnected before proceeding.

- a. Remove the power supply from the computer.
- b. Remove the ten screws securing the top cover of the power supply and lift off the top cover.
- c. Disconnect the fan power cords from the terminal board (TB1) in the power supply. (See figure 2-6.)
- d. Remove the four screws securing each fan to the right side of the power supply. Move the cables as necessary to remove the fans.

2-55. REPLACEMENT. Replace the ventilating fan(s) in reverse order of the removal procedure.**2-56. POWER FAIL RECOVERY SYSTEM****2-57. BATTERY REMOVAL.** Remove the battery packs as follows:

- a. Set the ~POWER and BATTERY switches to OFF.
- b. Loosen the four captive screws securing the I/O cage cover to the computer mainframe. Set the cage cover and battery box on a bench.
- c. Remove the four flat head screws securing the I/O cage cover to the battery box. Remove the cover.
- d. Lay the battery box with the side mounted to the I/O cage cover on the bottom and remove the four screws holding the battery cover in place. Remove the cover.
- e. Remove the four screws holding the battery packs; disconnect the connectors and remove the packs.

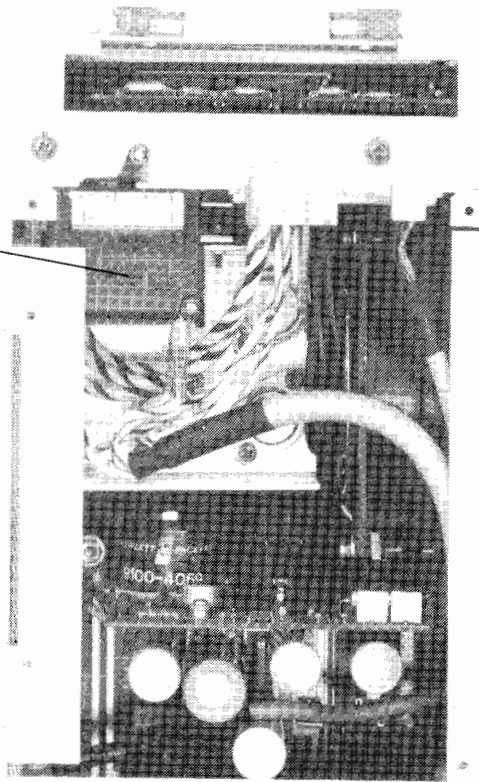
2-58. REPLACEMENT. Replace the battery packs in reverse order of the removal procedure.**2-59. BATTERY PCA REMOVAL.** Remove a battery PCA as follows:**WARNING**

Hazardous voltages are present with the ac power cord connected. Ensure that ac power cord is disconnected before proceeding.

- a. Set the ~POWER and BATTERY switches to the OFF position.
- b. With the operator panel lowered, slide the power supply retaining latches towards each other so that they disengage from the mainframe deck studs.
- c. Disconnect the two cables from the front of the power supply.
- d. Remove the two screws from the rear of the power supply securing it to the rear frame.
- e. Slide the power supply part way out of the rear of the computer and disconnect the upper fan power cords.
- f. Carefully remove the power supply from the computer.
- g. Remove the 10 screws from the top cover of the supply and lift off the cover.

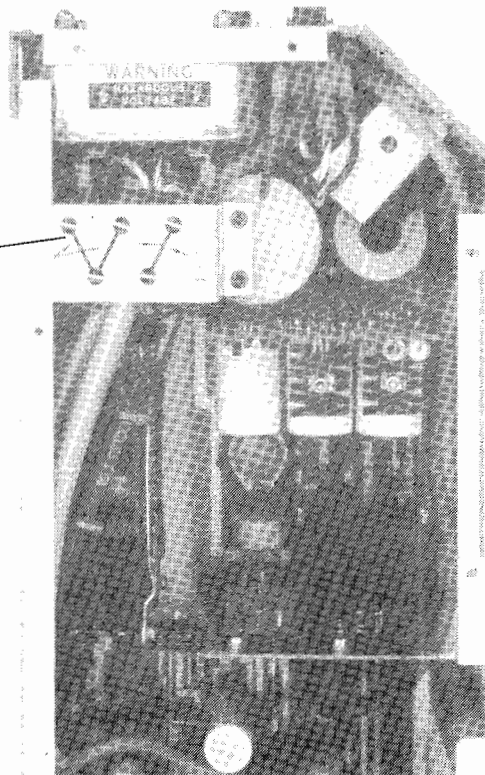


~ POWER OFF/ON
CIRCUIT BREAKER
(CB1)



7700-595

TERMINAL
BLOCK
(TB1)



7700-596

Figure 2-6. Power Supply Circuit Breaker and Terminal Block

- h. Grasp the Battery Backup PCA (figure 2-7) or the Battery Charger PCA and pull upward out of the board guides.

2-60. REPLACEMENT. Replace the battery PCA in the reverse order of the removal procedure.

2-61. UPPER VENTILATING FANS (HP 2111F)

WARNING

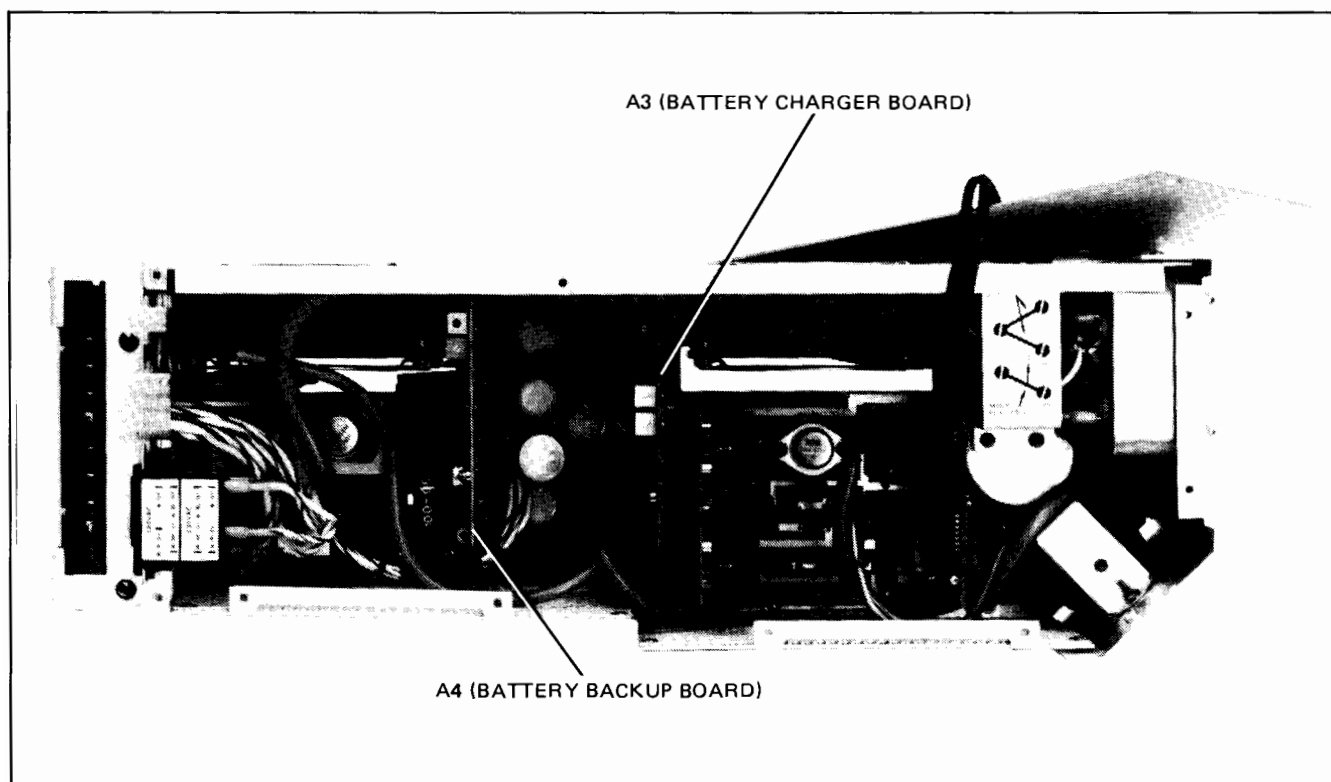
Hazardous voltages are present with the ac power cord connected. Ensure that ac power cord is disconnected before proceeding.

2-62. REMOVAL. Remove the floating point PCA's and proceed as follows:

- a. Remove the computer top and side covers.
- b. Remove the four screws securing the floating point (FP) PCA cage to the fan panel.

- c. Remove the three screws securing the FP PCA cage to the right frame strut. Remove the bracket securing the FP PCA cage to the memory PCA cage.
- d. Carefully press down on the right side of the cage and raise the left side until the cage can slide under the right frame strut. Carefully move the cage away from the fan panel.
- e. Remove the three screws securing the fan panel to the left frame strut and remove the screw securing the panel to the front frame.
- f. At the rear of the fan panel, loosen the two screws holding the panel clamp against the rear frame.
- g. Move the fan panel toward the front until the lip at the panel rear clears the rear frame. Lift the panel and lean it inward; remove the four screws securing a fan to the panel.
- h. Disconnect the fan power cord and remove the fan.

2-63. REPLACEMENT. Replace the ventilating fan in the reverse order of the removal procedure.



7700-73

Figure 2-7. Power Fail Recovery PCA's Locations in the Power Supply

2-64. UPPER VENTILATING FANS (HP 2117F)

WARNING

Hazardous voltages are present with the ac power cord connected. Ensure that ac power cord is disconnected before proceeding.

2-65. REMOVAL. Remove the computer top cover and proceed as follows:

- a. Disconnect the fan(s) power cord(s).
- b. Remove the two screws securing the computer's right side panel.
- c. Remove the three screws securing the power supply's front shield.
- d. Remove the six screws securing the upper fan panel to the computer.
- e. Pull the fan panel toward the front frame until the lip at the rear of the fan panel clears the rear frame. Then lift the fan panel up and out of the computer.
- f. Remove the four screws securing each fan.

2-66. REPLACEMENT. Replace the ventilating fan(s) in the reverse order of the removal procedure.

2-67. FLOATING POINT PROCESSOR POWER SUPPLY PCA'S

WARNING

Hazardous voltages are present within the FPP mainframe. Ensure that the ac power cord is disconnected before proceeding.

2-68. REMOVAL. Remove the +5V Regulator PCA's and Logic PCA from the FPP as follows:

- a. Remove six screws attaching FPP top cover to the mainframe.
- b. Remove the screw securing the PCA retainer; remove the retainer.
- c. To remove PCA, grasp it and pull it upward out of the board guides.

2-69. REPLACEMENT. Replace an FPP power supply PCA in reverse order of the removal procedure.

2-70. FLOATING POINT PROCESSOR POWER SUPPLY

WARNING

Hazardous voltages are present within the FPP mainframe. Ensure that the ac power cord is disconnected before proceeding.

2-71. REMOVAL. Remove the power supply from the FPP as follows:

- a. Remove six screws attaching FPP top cover to the mainframe.
- b. Disconnect the power cable at top of front fan.
- c. Remove seven screws (one on bottom of mainframe) securing power supply assembly to mainframe. Slide power supply out the rear of mainframe.

WARNING

When installing a power supply assembly, ensure that the voltage selector switch is positioned to the appropriate voltage before applying ac power.

2-72. REPLACEMENT. Replace the FPP power supply in reverse order of the removal procedure.

2-73. FLOATING POINT PROCESSOR VENTILATING FANS

WARNING

Hazardous voltages are present within the FPP mainframe. Ensure that the ac power cord is disconnected before proceeding.

2-74. REMOVAL. Remove the ventilating fans from the FPP as follows:

- a. Remove six screws attaching FPP top cover to the mainframe.
- b. Disconnect the power cable(s) at top of fan(s).
- e. Remove four screws securing each fan to mainframe. (Holes are provided to allow access to power supply fan screws.) Pull fan upward and out of mainframe.

2-75. REPLACEMENT. Replace FPP fan(s) in reverse order of the removal procedure.

2-76. FLOATING POINT BACKPLANE (HP 2111F)

2-77. REMOVAL. Remove the floating point backplane as follows:

- a. Set the ~POWER switch to OFF. Remove the computer top cover.
- b. Remove the I/O PCA cage cover and the I/O PCA retainer.
- c. Remove the two flat head screws securing the rear panel extension (above power supply rear). Remove the panel extension.
- d. Remove the screws securing the panel above the I/O PCA cage and remove the panel.
- e. Loosen the screws securing the five wires to the backplane and disconnect the wires.
- f. Remove the 10 screws securing the backplane and remove the backplane.

2-78. REPLACEMENT. Replace the backplane in the reverse order of the removal procedure.

2-79. MEMORY CAGE PCA'S

2-80. REMOVAL. Remove the printed-circuit assemblies (PCA's) from the memory cage as follows:

- a. Set ~POWER and BATTERY switches to OFF.
- b. Remove the two memory PCA cage cover retaining screws and lockwashers; remove memory PCA cage cover.
- c. Disconnect cable assembly(ies) from front edge connector(s). (The memory protect PCA does not have a front edge connector.) If removing the DCPC, do not disconnect the cable assembly from the crossover PCA; if removing the memory controller or memory module, disconnect the cable assembly from all PCA's.
- d. Remove PCA by pulling outward on extractor levers.

2-81. REPLACEMENT. Replace memory cage PCA's in the reverse order of the removal procedure. When installing a replacement memory module, be sure to configure the memory module address jumpers correctly.

2-82. MEMORY RECONFIGURATION

If desired or necessary, the HP 2102E and HP 2102H Memory Systems may be reconfigured. Reconfiguration requires assigning memory block numbers, reconfiguring module address jumpers or switches, reinstallation, and verification. Complete information on installing and ser-

ving the memory systems is given in the *High Performance Memory Systems Installation and Service Manual*, part no. 5955-4311.

2-83. MEMORY SELF-TEST.

To execute the memory self-test perform the following:

- a. Set P-register = 000000 (octal), press STORE.
- b. Set A-register = 100000 (octal), press STORE.
- c. Press PRESET.
- d. Set LOCK/OPERATE switch to LOCK.
- e. Press INSTRUCTION STEP. As the test executes the display register will consecutively count each 32K word segment of memory tested, starting at segment 0. If the count is not smooth or there is a skip, the memory module is misconfigured or a failure occurred in that segment. With 32K words or less the display register will remain off.
- f. If a data bit failure occurs, all display register lights will be lit and the OVERFLOW light will be off. If OVERFLOW is set (light on), a failure occurred in the CPU not in memory.

A parity bit or check bit error is indicated when the parity indicator is lit and the display register (data bits) do not light.

- g. For analysis of test indications, refer to the *High Performance Memory Systems Installation and Service Manual*, part no. 5955-4311.

2-84. 110/220 VAC RECONFIGURATION FOR COMPUTER MAINFRAME

To reconfigure the computer mainframe to operate from a 220-volt power source instead of a 110-volt power source (or vice versa), refer to figures 2-6 and 2-8 and proceed as follows:

WARNING

Hazardous voltages are present inside the power supply!! Before changing from 110V ac to 220V ac configuration, or vice versa, set ~POWER and BATTERY switches to OFF and disconnect the power cord!! Failure to observe this precaution can result in serious injury.

- a. Set the ~POWER and BATTERY switches to OFF and remove the power cord.

- b. Remove the top cover from the computer and disconnect the top ventilating fans power cords from the power supply.
- c. Remove the power supply from the computer.
- d. Remove the top cover from the power supply and the protective cover from TB1 (see figure 2-6).
- e. For 110 Vac operation, connect jumpers and wires as shown in figures 2-6 and 2-8.
- f. For 220 Vac operation, connect the jumpers and wires as shown in figures 2-6 and 2-8.
- g. Replace the protective cover over TB1, replace the power supply top cover, and replace the power supply into the computer.
- h. Ensure that the correct power cord set is used in the new configuration (see figure 1-6 or 1-7).

2-85. INPUT POWER CONFIGURATION FOR FLOATING POINT PROCESSOR

The Floating Point Processor (FPP) has a rear-panel selector switch for configuring the FPP to the line voltage to be used. The switch positions and the corresponding ac voltage ranges are as follows:

Switch Position	AC Voltage Range
100	90-110
120	108-132
220	198-242
240	216-164

If it is necessary to change the position of the line voltage selector switch, proceed as follows:

CAUTION

Do not adjust the line voltage selector switch while ac power is applied to the FPP. Before proceeding, set ~LINE switch to OFF and disconnect the power cord.

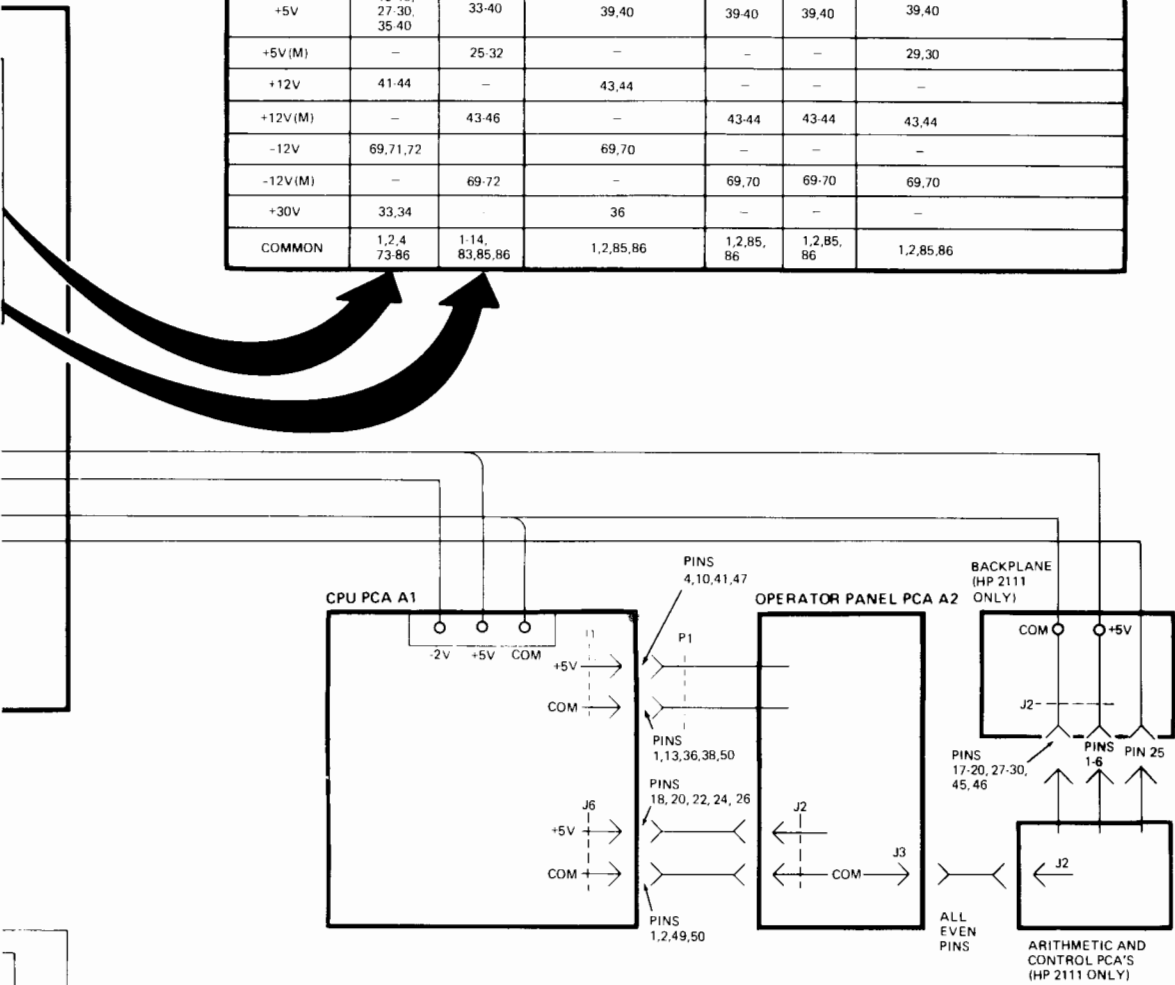
- a. Remove the voltage rating tag on the rear panel.
- b. Insert the tip of a screwdriver (or similar tool) into the slot on the switch. Turn the switch so that the indicated position corresponds to the line voltage to be used.
- c. Replace the voltage rating tag so that it indicates the selected voltage.
- d. Ensure that the correct power cord set is used in the new configuration (see figure 1-6 or 1-7).

2-86. DIAGRAMS

Figures 2-8 and 2-9 are power distribution diagrams for the computer mainframe and the Floating Point Processor, respectively. Figure 2-10 is a simplified block diagram of the F-Series computer.

BACKPLANE DC POWER DISTRIBUTION						
DC VOLTAGE	CROSS OVER PCA A6		INPUT OUTPUT BACKPLANE A4	MEMORY BACKPLANE A5		
	X A4	X A5	X A10 X A25 X A10 X A20	X A110	X A111	X A112 X A123 (HP 2117B) X A112 X A118 (HP 2111B)
-2V	47.52	47.52	47.48	47.48	47.48	47.48
+5V	15.18, 27.30, 35.40	33.40	39.40	39.40	39.40	39.40
+5V(M)	—	25.32	—	—	—	29.30
+12V	41.44	—	43.44	—	—	—
+12V(M)	—	43.46	—	43.44	43.44	43.44
-12V	69.71,72	—	69.70	—	—	—
-12V(M)	—	69.72	—	69.70	69.70	69.70
+30V	33.34	—	36	—	—	—
COMMON	1,2,4 73.86	1-14 83,85,86	1,2,85,86	1,2,85, 86	1,2,85, 86	1,2,85,86

361-1388



NOTES:

- 1 DENOTES REAR PANEL NOMENCLATURE
 DENOTES OPERATOR PANEL NOMENCLATURE

WARNING

HAZARDOUS VOLTAGES ARE PRESENT INSIDE THE POWER SUPPLY!! BEFORE CHANGING FROM 110 VAC TO 220 VAC CONFIGURATION, OR VICE VERSA, SET POWER SWITCH TO OFF AND DISCONNECT THE POWER CARD!! FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN SERIOUS INJURY.

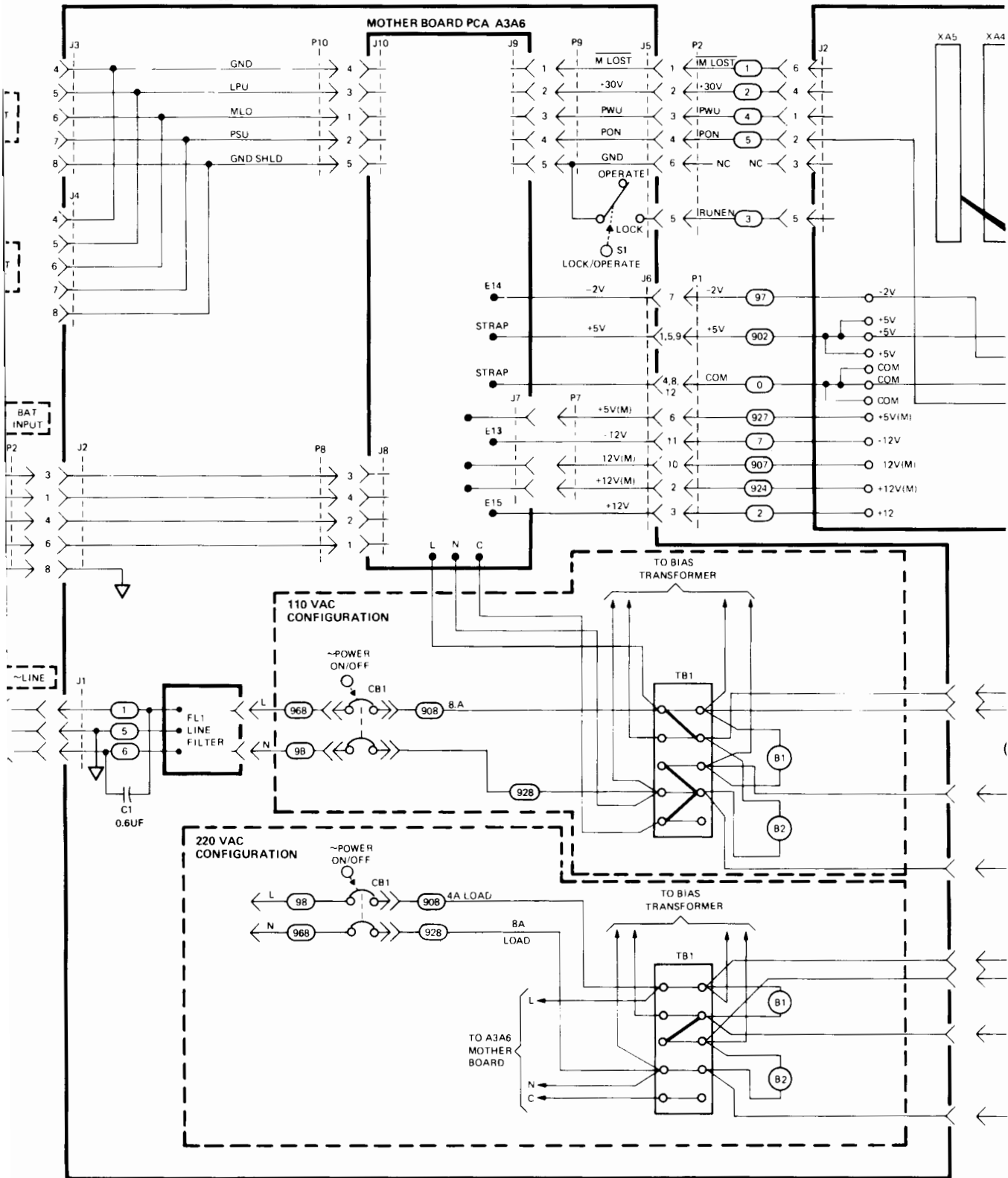
2. ENCLOSURES WIRE COLOR CODE. CODE USED IS THE SAME AS THE RESISTOR COLOR CODE. FIRST NUMBER IDENTIFIES THE BASE COLOR, SECOND NUMBER IDENTIFIES THE WIDER STRIPE, AND THE THIRD NUMBER IDENTIFIES THE NARROWER STRIPE, E.G., (947) DENOTES WHITE BASE, YELLOW WIDE STRIPE, VIOLET NARROW STRIPE.



Figure 2-8. Computer Mainframe Power Distribution Diagram

POWER SUPPLY ASSY. A3 5061-3476

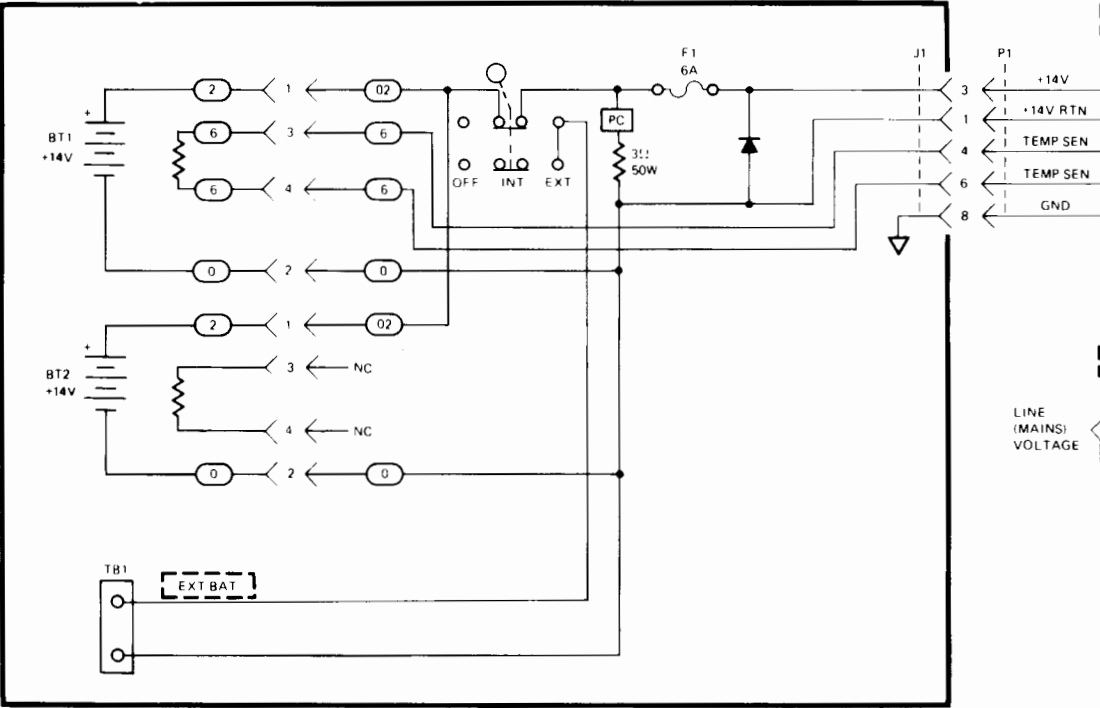
CROSS OVER BOARD ASSY. A6 5061-3476



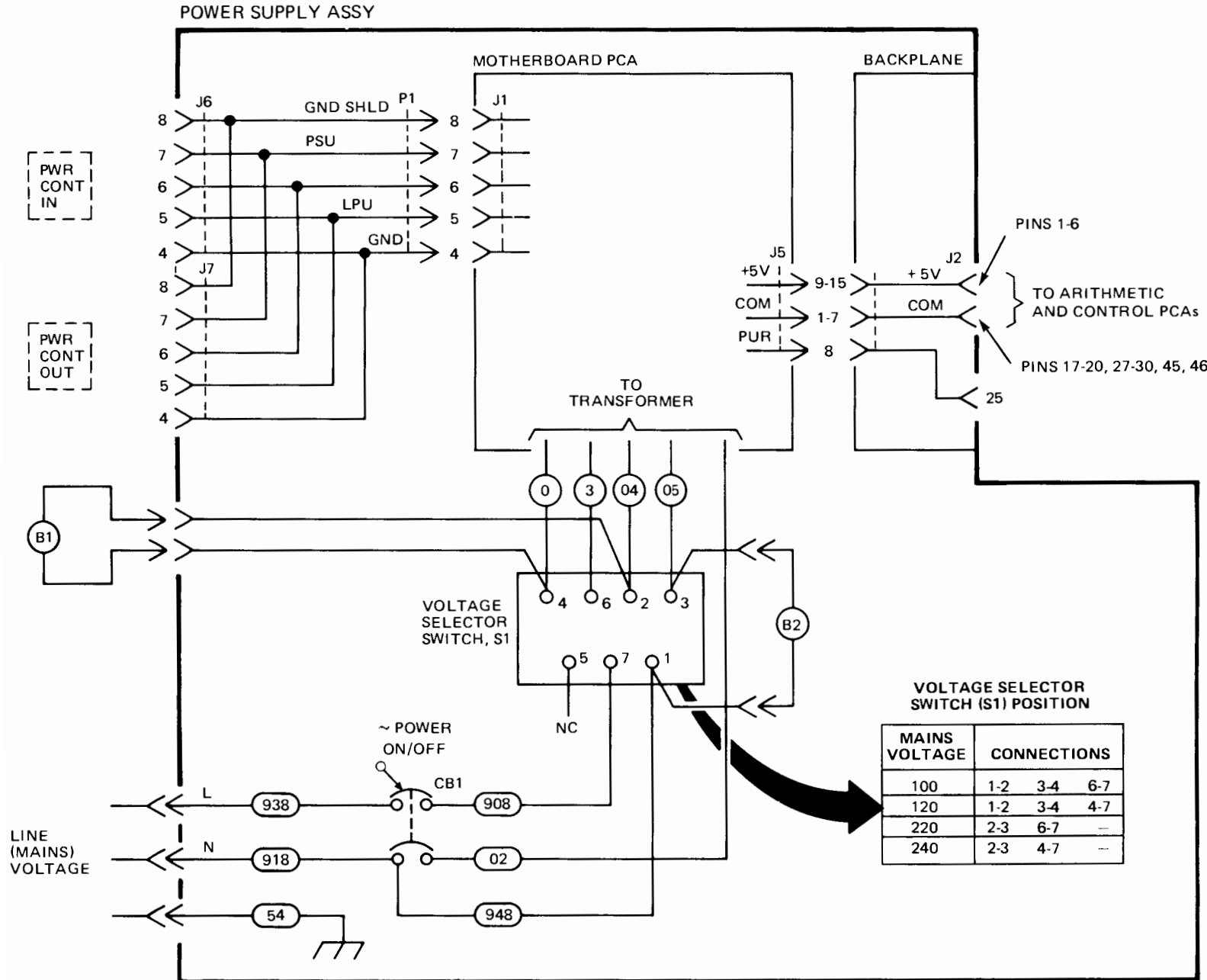
PWF
CON
IN

PWF
CON
OUT

HP 12991B



LINE
(MAINS)
VOLTAGE



NOTES:

CAUTION

DO NOT CHANGE VOLTAGE SELECTOR SWITCH POSITION WHILE AC POWER IS APPLIED.

- ENCLOSES WIRE COLOR CODE. CODE USED IS THE SAME AS THE RESISTOR COLOR CODE. FIRST NUMBER IDENTIFIES THE BASE COLOR, SECOND NUMBER IDENTIFIES THE WIDER STRIPE, AND THE THIRD NUMBER IDENTIFIES THE NARROWER STRIPE, e.g.,
- 947 DENOTES WHITE BASE, YELLOW WIDE STRIPE, VIOLET NARROW STRIPE.

7700-173

Figure 2-9. HP Floating Point Processor Power Distribution Diagram

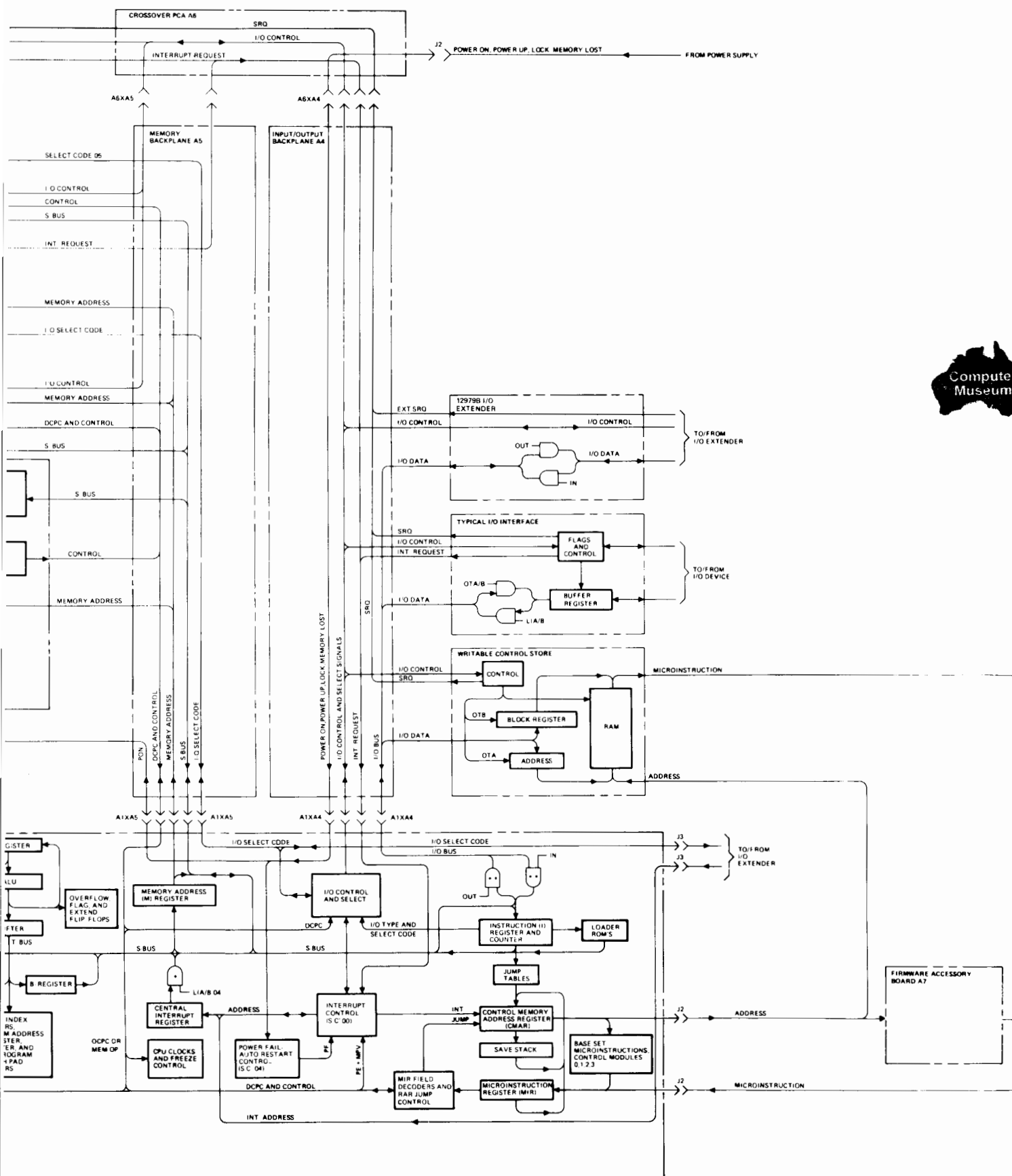
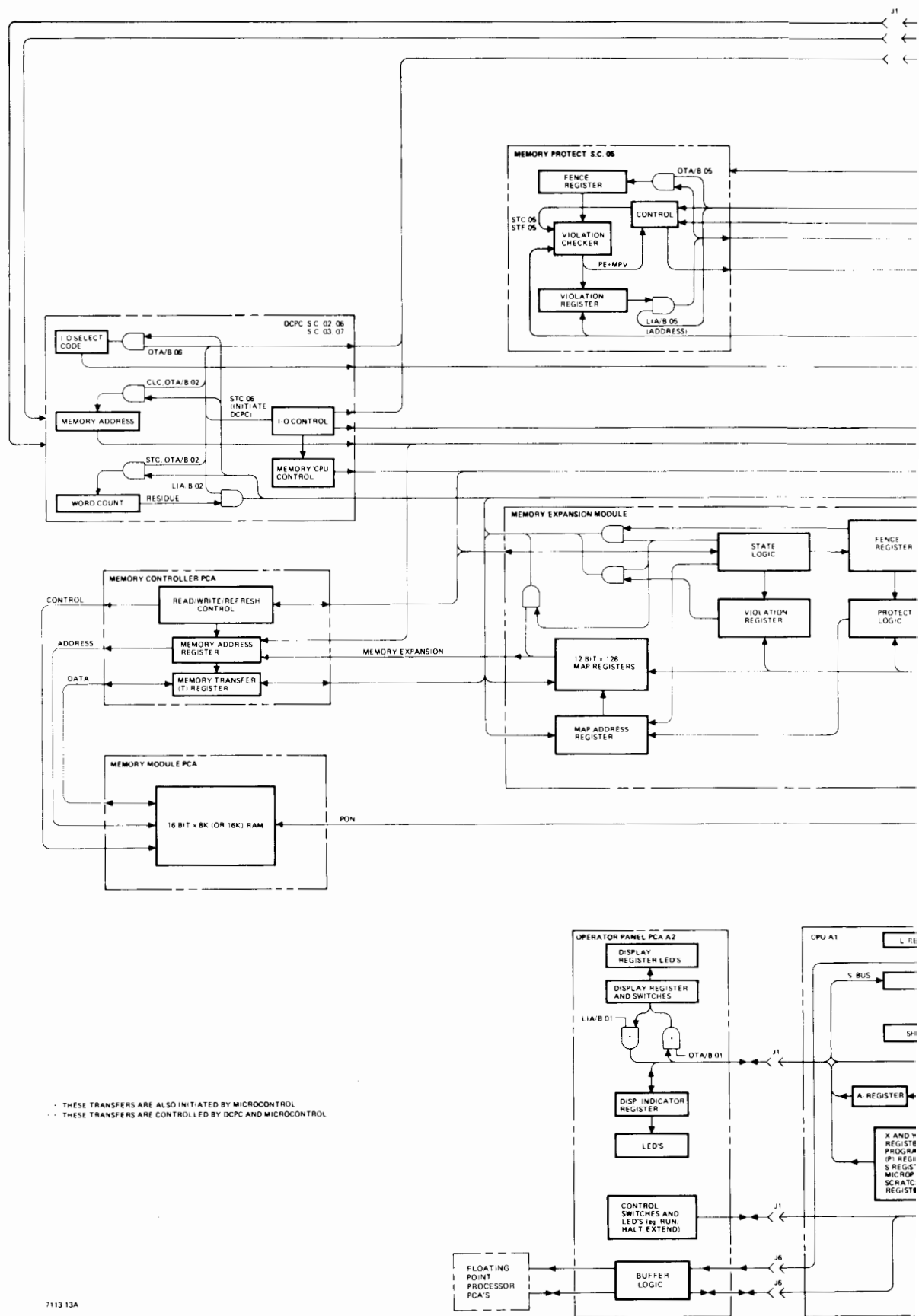


Figure 2-10. HP 1000 F-Series Computer Simplified Block Diagram



REPLACEABLE PARTS

SECTION

III

This section provides a field-replaceable parts listing and an illustrated parts breakdown of the HP 2111F and HP 2117F Microprogrammable Computers. Component parts of most printed-circuit assemblies (PCA's) are not included, since these parts are considered replaceable only at the factory or a depot. Included in this section is a listing of subassemblies that comprise the High Performance and Fault Control Memory Systems and the power supply.

3-1. COMPUTER REPLACEABLE PARTS

Tables 3-1 and 3-2 and figures 3-1 and 3-2 list and illustrate the field-replaceable parts of the HP 2111F and HP 2117F Microprogrammable Computers. The replaceable parts are referenced to the exploded views by index numbers. The columns in the index numbered lists provide the following information for each part:

- a. **FIG & INDEX NO.** The figure and index number where the replaceable parts are shown in an exploded view.
- b. **HP PART NO.** The HP part number for each replaceable part.
- c. **DESCRIPTION.** The description of each replaceable part and its applicable reference designation.
- d. **MFR CODE.** A five digit code that denotes the manufacturer of the part. Refer to table 3-6 for a listing of the manufacturers that correspond to the codes.
- e. **MFR PART NO.** The manufacturer's part number for each replaceable part. Commercially obtainable parts are designated OBD (order by description).
- f. **UNITS PER ASSY.** The total quantity of each replaceable part of the computer or memory system.

3-2. POWER SUPPLY REPLACEABLE PARTS

Figure 3-3 and table 3-3 illustrates and lists the field-replaceable parts of the power supply.

3-3. FLOATING POINT PROCESSOR REPLACEABLE PARTS

Figure 3-4 and table 3-4 illustrates and lists the field-replaceable parts of the Floating Point Processor.

3-4. MEMORY SYSTEM REPLACEABLE PARTS

Table 3-5 lists the field-replaceable parts of the High Performance and Fault Control Memory Systems.

3-5. ORDERING INFORMATION

To order replaceable parts, address the order to the local Hewlett-Packard Sales and Service Office listed at the end of this manual. (For I/O interface PCA or I/O device ordering information, refer to their respective manuals.) The following information should be included in the order for each replaceable parts:

- a. Complete model number (including options and accessories) and serial number.
- b. Hewlett-Packard part number for each part.
- c. Complete description for each part as provided in the replaceable parts lists.

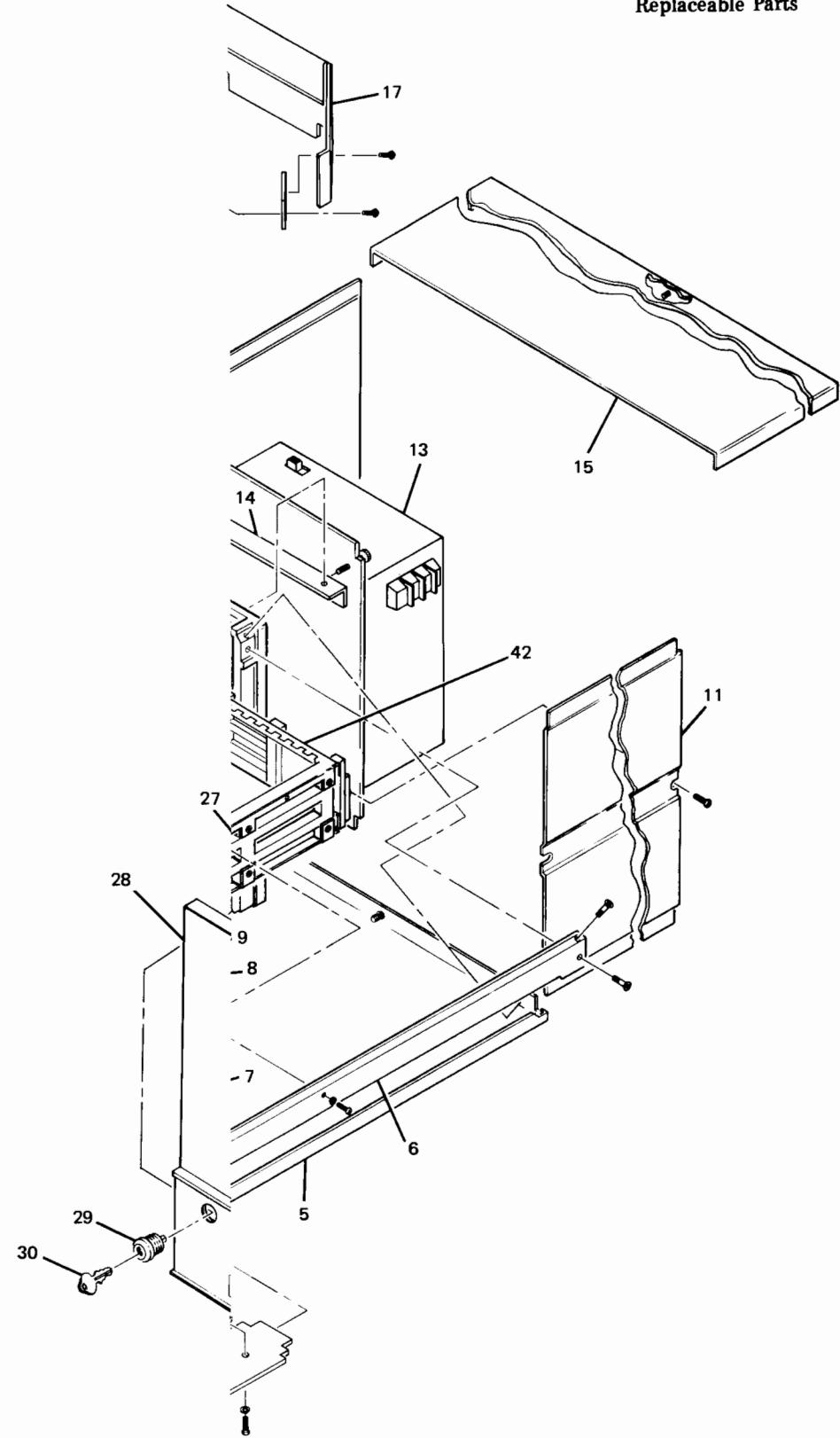


Table 3-1. HP 2111F Computer Replaceable Parts

INDEX NO.	HP PART NO.	DESCRIPTION	MFR. CODE	MFR. PART NO.	UNITS/ ASSY.
1	02108-00035	Memory PCA Cage Cover	28480	02108-00035	1
2	5061-1400	Central Processor Unit A1†	28480	5061-1400	1
**3	—	Memory PCA Cage Assembly	28480	—	1
4	13304-60001	Firmware Accessory Board A7†	28480	13304-60001	1
5	5061-1945	Bottom Cover	28480	5061-1945	1
6	5020-8838	Corner Struts	28480	5020-8838	4
7	5061-1336	Connector Assembly	28480	5061-1336	1
8	5000-8087	Universal Deck	28480	5000-8087	1
**9	—	I/O PCA Cage Assembly	28480	—	1
10	5020-8808	Rear Frame	28480	5020-8808	1
11	02108-00017	Side Cover	28480	02108-00017	2
12	5000-8094	Rear Cover (Battery)	28480	5000-8094	1
*13	12991-60001	Battery Box Assembly	28480	12991-60001	1
14	5001-2627	Mounting Bracket	28480	5001-2627	1
15	5061-1945	Top Cover	28480	5061-1945	1
16	5001-2602	Card Retainer	28480	5001-2602	1
17	5000-8093	Rear Panel Extension	28480	5000-8093	1
18	5061-3476	Power Supply Assembly A3	28480	5061-3476	1
19	5061-1388	Crossover Board Assembly A6	28480	5061-1388	1
20	5001-2604	Card Cage Shield	28480	5001-2604	1
21	—	Protective Cover (p/o 18)	28480	—	—
22	9220-2078	Foam Pad	02900	—	2
23	5020-7335	Front Frame	28480	5020-7335	1
24	5001-2612	Lock Retainer	28480	5001-2612	1
25	4040-0572	Operator Panel PCA Cover (p/o 28)	28480	4040-0572	1
26	5061-1343	Operator Panel PCA (p/o 28)	28480	5061-1343	1
26A	1990-0529	Light Emitting Diode	28480	1990-0529	28
26B	02108-00014	Spring Contact	28480	02108-00014	22
26C	5040-6076	Switch (Mint Gray)	28480	5040-6076	13
26C	5040-6077	Switch (Jade Gray)	28480	5040-6077	9
27	5001-2638	Lock Latch	28480	5001-2638	1
28	02113-00002	Front Panel Extension	—	—	1
29	1390-0344	Lock Assembly	02694	15748/4T1427 (SPECIAL)	1
30	1390-0345	Key 4T1427 (p/o 29)	02694	8632C-R1/ 4T1427	1
31	5001-2635	Front-Sub Panel	—	—	1
32	8300-0013	Front Panel Cable	28480	8300-0013	1
33	0570-0528	Press-In Stud	01836	—	2
34A	5001-2640	Hinge Plate (Right)	28480	5001-2640	1
34B	5001-2641	Hinge Plate (Left)	28480	5001-2641	1
35	5061-1382	Memory Backplane A5	28480	5061-1382	1
36	02108-60007	I/O Backplane A4	28480	02108-60007	1
*37	12897-60002	DCPC Cable Assembly	28480	12897-60002	1
38	5061-1363	Crossover Cable Assembly	28480	5061-1363	1
39	5061-1364	Status Cable Assembly	28480	5061-1364	1
40	5061-1397	CPU-MPP Cable Assembly	28480	5061-1397	1
41	02111-60005	FPP-MPP Cable Assembly	28480	02111-60005	1
	12740-60001	Arithmetic PCA	28480	12740-60001	1
	12740-60002	Control PCA	28480	12740-60002	1
42	02111-60004	FPP Backplane	28480	02111-60004	1
43	4040-1355	Front Panel Overlay	—	4040-1355	1

*HP accessory; shown only for reference.
 **Not field replaceable; shown for reference only.
 †Instruction ROMs not included.

Replaceable Parts



7700-204

Figure 3-1. HP 2111F Computer Exploded View

Table 3-2. HP 2117F Computer Mainframe Replaceable Parts

INDEX NO.	HP PART NO.	DESCRIPTION	MFR. CODE	MFR. PART NO.	UNITS/ ASSY.
1	02112-00032	Memory PCA Cage Cover	28480	02112-00032	1
2	5061-1400	Central Processor Unit A1†	28480	5061-1400	1
**3	—	Memory PCA Cage Assembly	28480	—	1
4	13304-60001	Firmware Accessory Board A7†	28480	13304-60001	1
5	12740-00016	Bottom Cover	28480	12740-00016	1
6	5020-8838	Corner Struts	28480	5020-8838	4
7	5061-1336	Connector Assembly	28480	5061-1336	1
8	5000-8087	Universal Deck	28480	5000-8087	1
9	—	I/O PCA Cage Assembly	28480	—	1
10	02112-00017	Support Bracket	28480	02112-00017	1
11	5020-8812	Rear Frame	28480	5020-8812	1
12	5060-9958	Side Cover	28480	5060-9958	2
13	02112-00029	Rear Cover (Battery)	28480	02112-00029	1
*14	12991-60001	Dual Battery Box Assembly	28480	12991-60001	1
15	5061-2627	Mounting Bracket	28480	5061-2627	1
16	5061-1945	Top Cover	28480	5061-1945	1
17	5000-8093	Rear Panel Extension	28480	5000-8093	1
18	5001-2636	Rear Panel Extension Bracket	28480	5001-2636	2
19	5001-2637	Card Retainer	28480	5001-2637	1
20	5061-3476	Power Supply Assembly A3	28480	5061-3476	1
21	5061-1388	Cross-over Board Assembly A6	28480	5061-1388	1
22	02112-00031	Fan Assembly Retainer	28480	02112-00031	1
23	02112-00016	Card Cage Shield	28480	02112-00016	1
24	5001-2639	Upper Level Shield	28480	5001-2639	1
25	—	Protective Cover (p/o 20)	28480	—	—
26	02112-60019	Upper Ventilating Fan w/cable	28480	02112-60019	2
27	02112-90007	Upper Ventilating Fan Assy	28480	02112-90007	1
28	5020-7333	Front Frame	28480	5020-7333	1
29	9220-2078	Foam Pad	02900	—	2
30	5001-2612	Lock Retainer	28480	5001-2612	1
31	4040-0572	Operator Panel PCA Cover (p/o 34)	28480	4040-0572	1
32	5061-1343	Operator Panel PCA A2 (p/o 34)	28480	5061-1343	1
32A	1990-0529	Light Emitting Diode	28480	1990-0529	28
32B	02108-00014	Spring Contact	28480	02108-00014	22
32C	5040-6076	Switch (Mint Gray)	28480	5040-6076	13
32C	5040-6077	Switch (Jade Gray)	28480	5040-6077	9
33	5001-2638	Lock Latch	28480	5001-2638	1
34	02113-00002	Front Panel Extension	28480	02113-00002	1
35	1390-0344	Lock Assembly	02694	15748/4T1427 (SPECIAL)	1
36	1390-0345	Key 4T1427 (p/o 35)	02694	8632C-R1/ 4T1427	1
37	5001-2635	Front Sub-Panel	28480	—	1
38	8300-0013	Front Panel Cable	28480	8300-0013	1
39A	5001-2640	Hinge Plate (Right)	28480	5001-2640	1
39B	5001-2641	Hinge Plate (Left)	28480	5001-2641	1
40	0570-0528	Press-In Stud	01836	—	2
41	5061-1383	Memory Backplane A5	28480	5061-1383	1
42	02112-60001	I/O Backplane A4	28480	02112-60001	1
*43	12897-60002	DCPC Cable Assembly	28480	12897-60002	1
44	5061-1363	Crossover Cable Assembly	28480	5061-1363	2
45	5061-1364	Status Cable Assembly	28480	5061-1364	1
46	5061-1397	CPU-MPP Cable Assembly	28480	5061-1397	1
47	4040-1355	Front Panel Overlay	—	4040-1355	1

*HP accessory; shown only for reference.
 **Not field replaceable; shown only for reference.
 †Instruction ROMs not included.

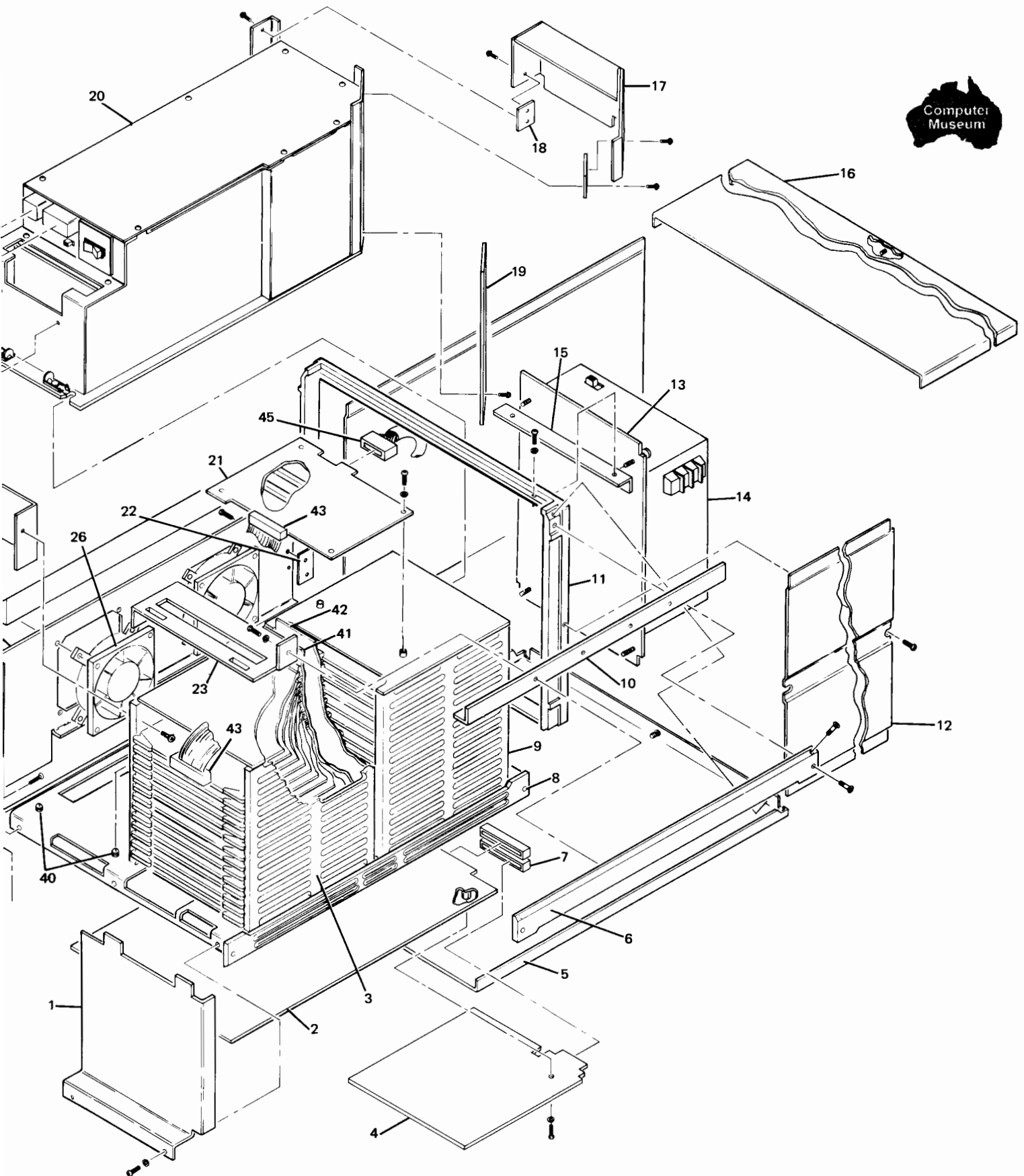
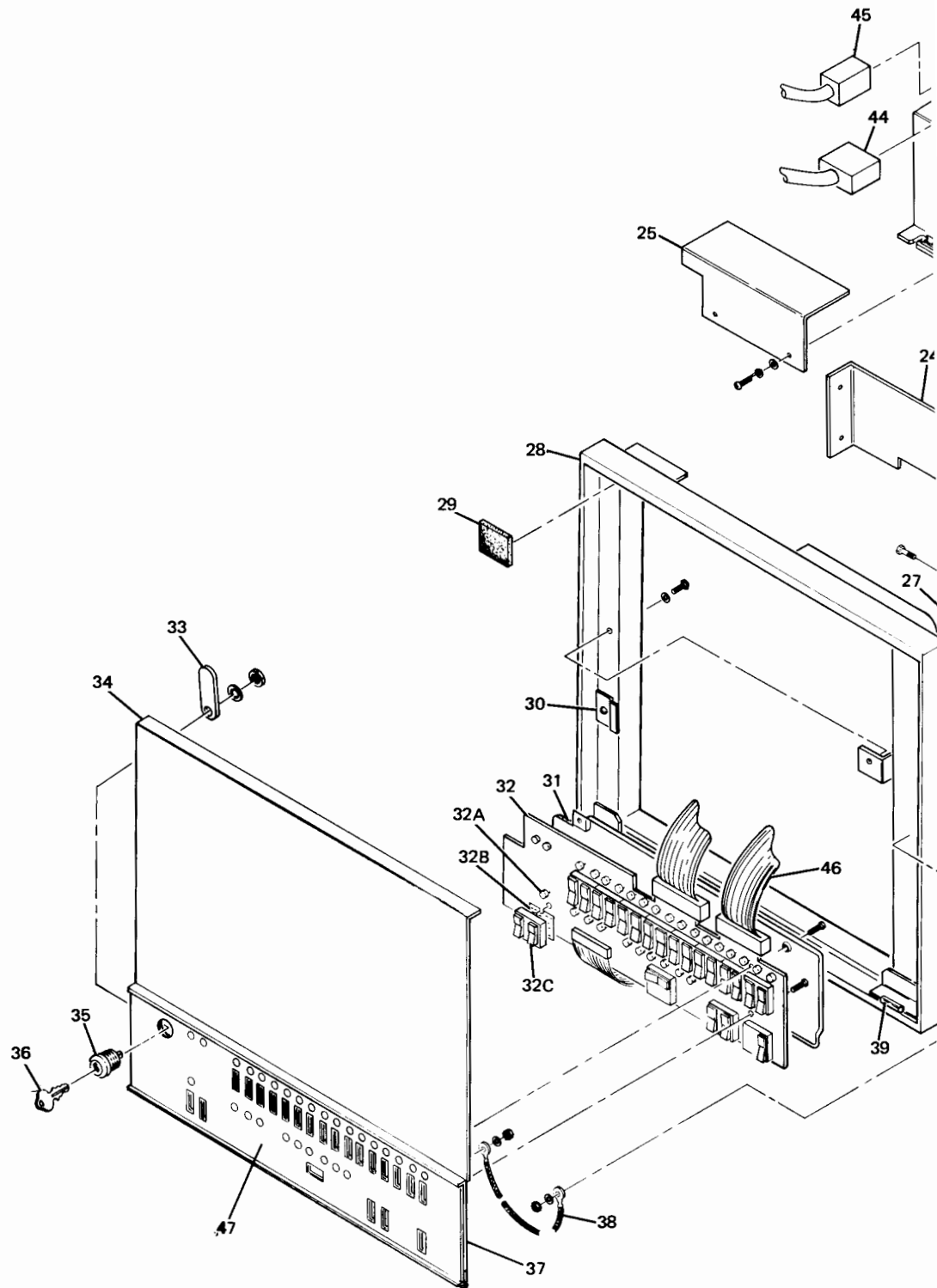
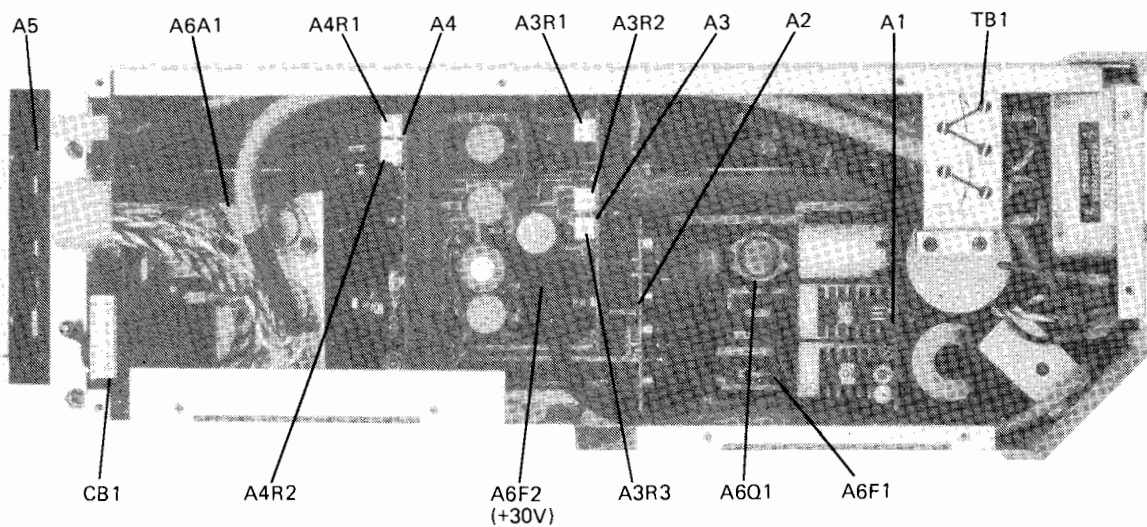


Figure 3-2. HP 2117F Computer Mainframe Exploded View

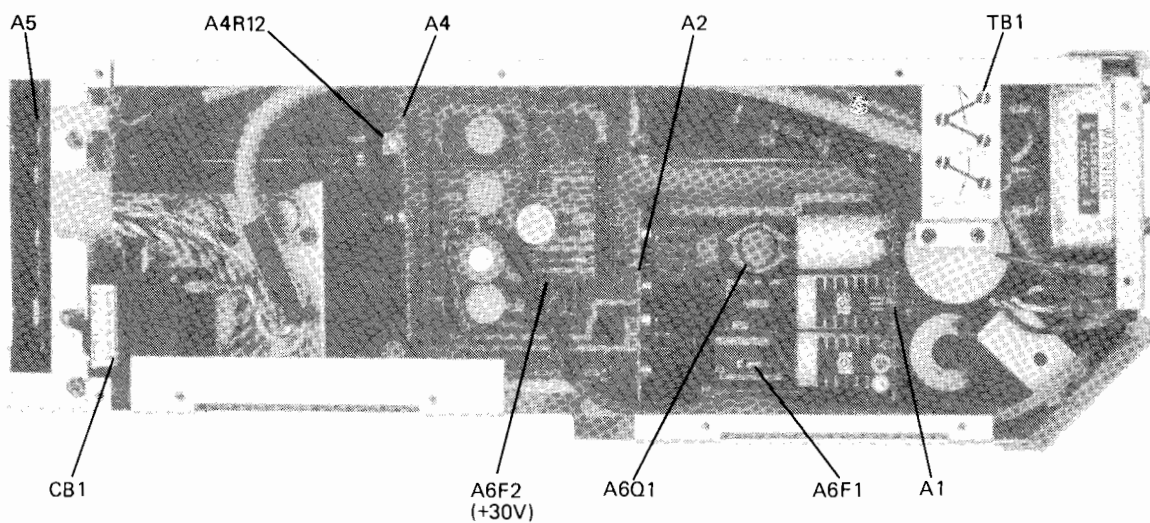


WITH BATTERY BACKUP



7700-597

WITHOUT BATTERY BACKUP



NOTE: Reference designations are shown without assembly A3 prefix (e.g., A5 is A3A5)

7700-598

Figure 3-3. Power Supply Interior View, With and Without Battery Backup Boards

Table 3-4. Floating Point Processor Replaceable Parts

INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
1	12740-60001	FPP Arithmetic PCA	28480	12740-60001	1
2	12740-60002	FPP Control PCA	28480	12740-60002	1
3	12740-60007	Power Supply Assy	28480	12740-60007	1
4	3105-0120	Circuit Breaker (CB1; ~LINE)	28480	3105-0120	1
5	3160-0218	Power Supply Fan (B2)	03495	WS2107FL-52	1
6	12740-20003	PCA Retainer	28480	12740-20003	1
7	12740-60005	+5V Regulator PCA	28480	12740-60005	2
8	12740-60006	Logic PCA	28480	12740-60006	1
9	3160-0218	Fan (B1)	03495	WS2107FL-52	1
10	8120-2219	Power Cord	02805	17250C	1
11	12740-00007	FPP Top Cover	28480	12740-00007	1
12	5040-6093	Front Panel	28480	5040-6093	1
13	12740-60008	FPP-MPP Cable	28480	12740-60008	1

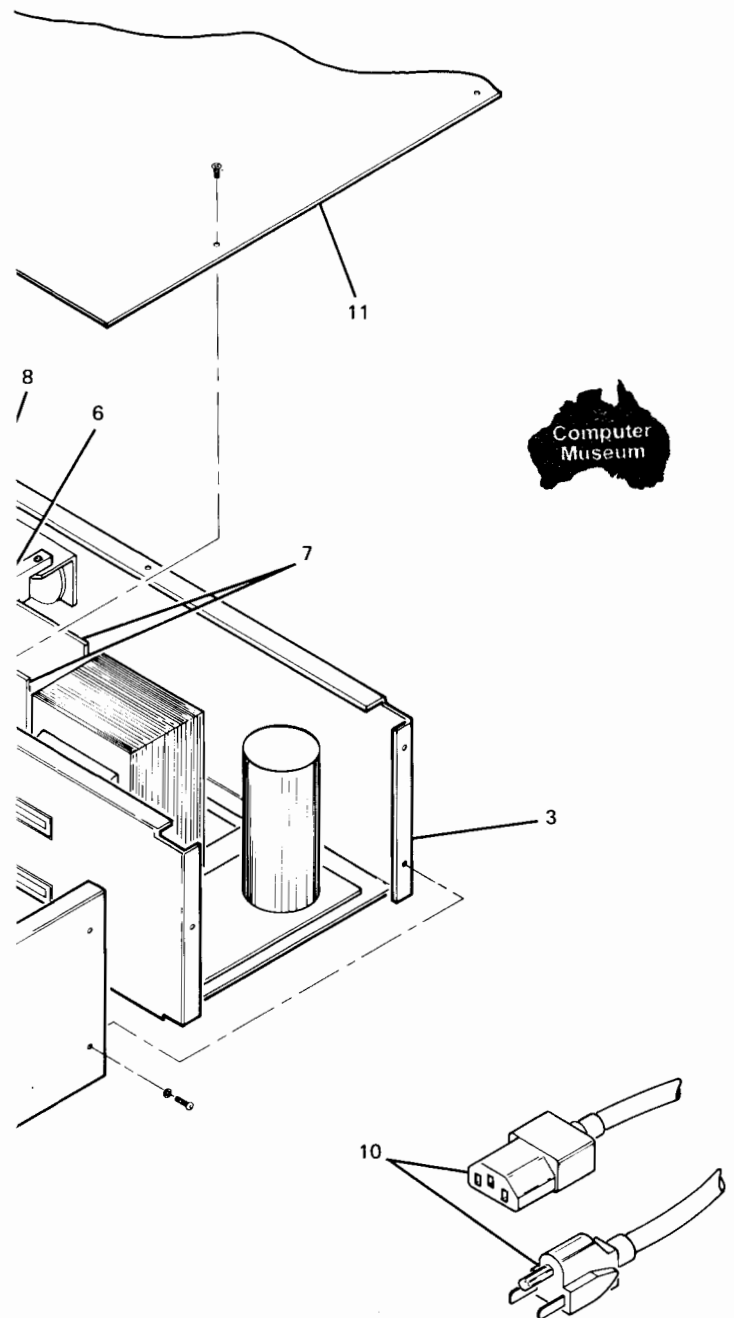


Figure 3-4. Floating Point Processor Exploded View

Table 3-5. Memory Systems and Accessories Replaceable Parts

HP PART NO.	DESCRIPTION	MFR. CODE	MFR. PART NO.	UNITS/ ASSY.
2102E	HIGH PERFORMANCE MEMORY SYSTEM	28480	2102E	1
02102-60002	Memory Controller PCA	28480	02102-60002	1
12741A	32k Byte Memory Module	28480	12741A	Note 1
12747H	128k Byte Memory Module	28480	12747H	Note 1
02112-60016	Memory System Cable	28480	02112-60016	1
2102H	HIGH PERFORMANCE FAULT CONTROL MEMORY SYSTEM	28480	2102H	1
02102-60004	Fault Control Memory Controller PCA	28480	02102-60004	1
12779H	Fault Control Check Bit Array	28480	12779H	Note 1
12780H	Fault Control Check Bit Array	28480	12780H	Note 1
12741A	32k Byte Memory Module	28480	12741A	Note 1
12747H	128k Byte Memory Module	28480	12747H	Note 1
02108-60041	Memory System Cable	28480	02108-60041	1
02112-60016	Memory System Cable	28480	02112-60016	1
	ACCESSORIES			
12892B	Memory Protect	28480	12892-60003	1
12897A	Dual-Channel Port Controller	28480	12897-60001	1
12897-60002	DCPC Cable Assembly	28480	12897-60002	1
Note 1: Depends on particular installations.				

Table 3-6. Code List of Manufacturer

The following code numbers are from the Federal Supply Code for Manufactures Cataloging Handbooks H4-1 and H4-2 and their latest supplements.					
CODE NO.	MANUFACTURER	ADDRESS	CODE NO.	MANUFACTURER	ADDRESS
01836	Asco Screw Co.	San Carlos, Ca.	04713	Motorola Inc.	
02694	Corbin Cabinet Lock Div.			Semiconductor Prod. Div.	Phoenix, Az.
	Emhart Corp.	Berlin, Ct.	05008	AirPax Electronics Inc.	Cambridge, Mo.
02900	Wilshire Foam Products Inc.	Torrence, Ca.	07263	Fairchild Camera and Instrument Corp.	
03038	International Rectifier			Semiconductor Div.	Mt. View, Ca.
	Semicon Div.	El Segundo, Ca.	71400	Bussman Manufacturing Div.	
03495	IMC Magnetism Corp. NH Div.	Rochester, N.H.		McGraw-Edison Co.	St. Louis, Mo.